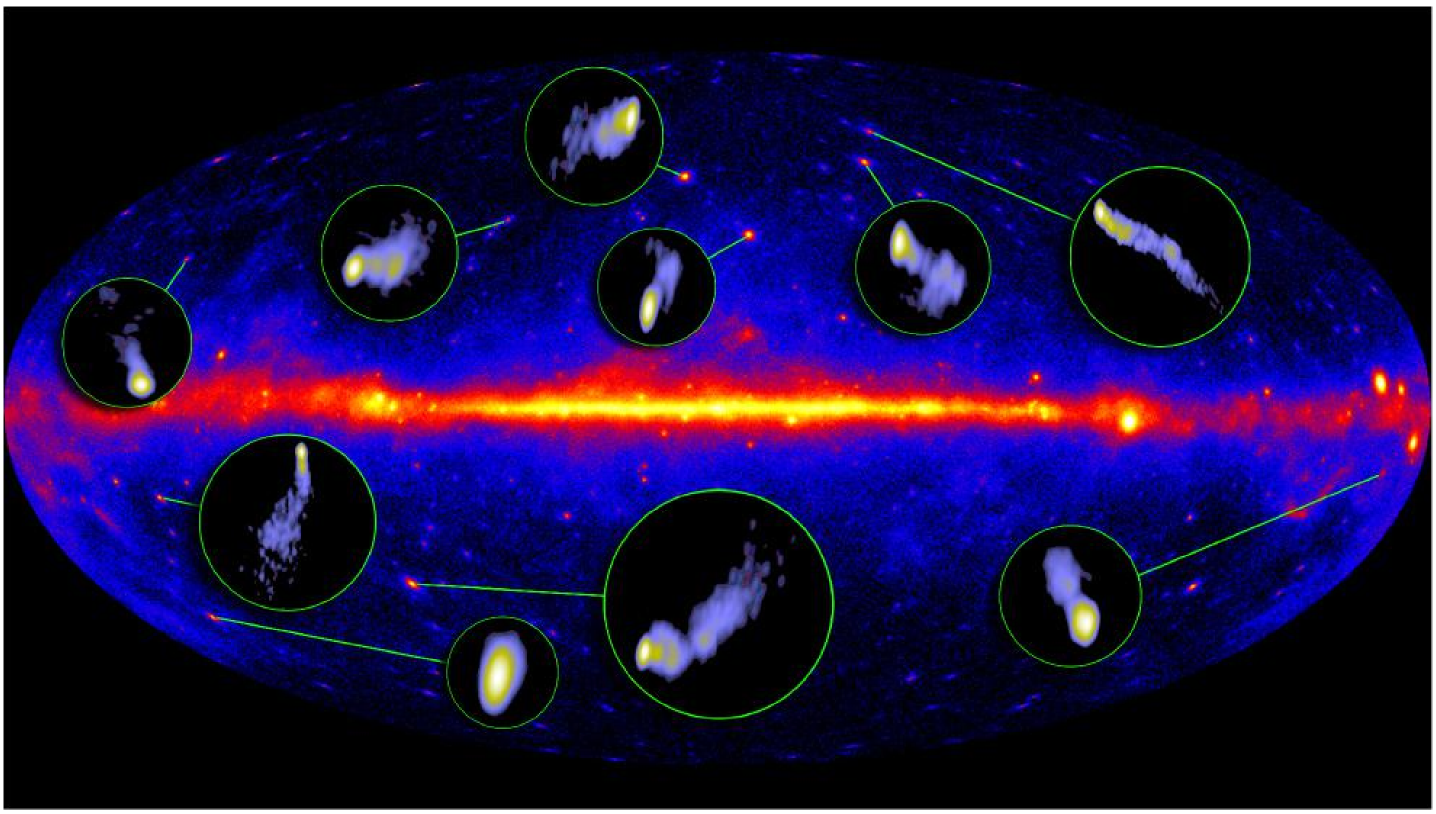
Physics INTERACTIONS

A NEWSLETTER HIGHLIGHTING THE DEPARTMENT OF PHYSICS AT PURDUE UNIVERSITY

2013

The MOJAVE Collaboration Investigates Cosmic Jets from Supermassive Black Holes



The gamma-ray sky as seen by NASA's Fermi Observatory. The insets show the radio emission from individual gamma-ray emitting jets as seen by the Very Long Baseline Array.

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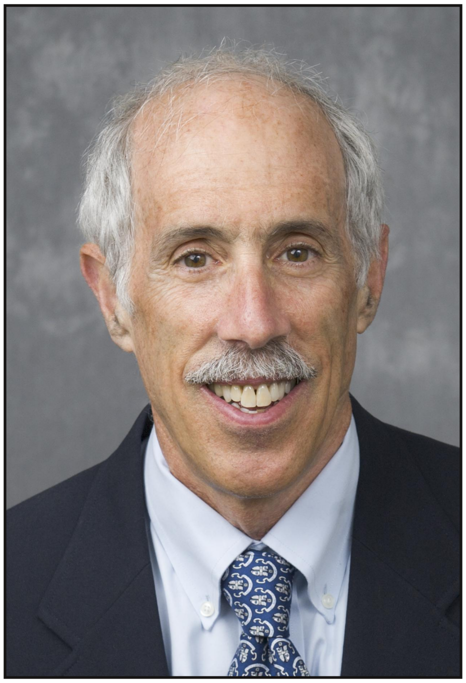

From the Head

I am pleased to bring you a new issue of ***Physics Interactions***. After a brief respite of 6 years, I have returned as Interim Department Head as a result of Nick Giordano assuming the position of Dean of the College of Sciences and Mathematics at Auburn University. Nick's leadership will be sorely missed, but we are certain that Auburn will be the beneficiary of his vision and energy. I also must report the departure of Professors Daniela Bortoletto and Ian Shipsey for Oxford University in the UK. Ian and Daniela have contributed in so many ways to raising the international visibility of our high energy particle physics effort that I could hardly begin to account for them here. Needless to say, their impact on the department and on the many students with whom they interacted over the years has been enormous.

With a new academic year comes opportunity! We have faculty searches underway in the areas of experimental AMO (atomic, molecular and optical) physics, theoretical biological physics, and experimental particle physics. In addition, three university-wide "cluster" initiatives in "Big Data", Quantum Optics, and "K-12 Integrated STEM (science, technology, engineering, and mathematics) Teacher Education" present great opportunities for the department to contribute to these major initiatives. I hope to report the results of our searches in the next issue of ***Physics Interactions***.

You are likely already aware that this is a very challenging era for higher education. At the same time when securing for funding for fundamental science has become ever more competitive, we find U. S. physics bachelor degrees at an all time high (http://www.aip.org/statistics/trends/reports/fall2013a.pdf). Indeed, we have experienced a doubling of our majors from about 90 in 1992 to about 200 today! Our outstanding faculty have been successful in funding their ground-breaking research, some of which you will read about in this issue. And undergraduates play a significant role in this enterprise by getting involved in research early and often.

Lastly, I call your attention to the photograph on page 11 of Roberto Colella, Al Overhauser, and Sam Werner in their younger days when they performed the now-famous COW experiment. The department was proud last spring to celebrate Al's remarkable career with the first of what will be a series of Overhauser Memorial Lectures. Look for an announcement on our home page of this year's lecture, and if you are in the neighborhood, do plan to attend.

Credits

Physics Interactions is published annually by the Department of Physics at Purdue University.

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Front Cover Credit: MOJAVE Program

Faculty Honors

Lynn Bryan was named Director of the Center for Advancing the Teaching and Learning of STEM.

Marc Caffee received the Ruth and Joel Spira Award for Outstanding Undergraduate Teaching.

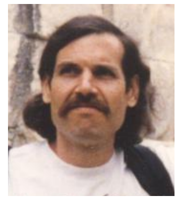
Erica Carlson was promoted to Professor and received an APS-IUSSTF Professorship Award.

Yong Chen was named a University Faculty Scholar.

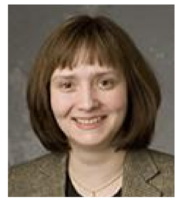
Chris Greene received the 2013 Hamburg Prize for Theoretical Physics and was named the Albert Overhauser Distinguished Professor of Physics.

Mark Haugan was named Associate Department Head.

Matthew Lister was promoted to Professor and received a College of Science Research Award.



Sherwin Love received the Ruth and Joel Spira Award for Outstanding Graduate Teaching.



Oana Malis received a National Science Foundation CAREER Award.

Michael Manfra was promoted to Professor.

David Nolte was named a Fellow of the American Association for the Advancement of Science and a Purdue University Discovery Park Fellow.

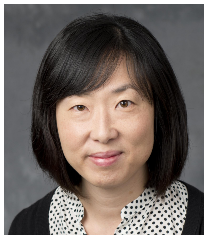
Laura Pyrak-Nolte was named a Fellow of the American Rock Mechanics Association.

Leonid Rokhinson was promoted to Professor.

Wei Xie was promoted to Associate Professor.

New Faculty

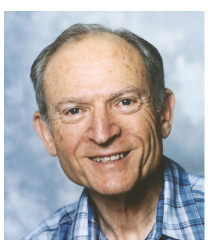
Nastasha Johnson, Assistant Professor of Library Science and Physical and Mathematical Information Specialist, is the Physics Library Liaison. She joins Purdue Libraries from North Carolina A&T State University. She holds a MLS from North Carolina Central University with an emphasis in academic libraries. Her areas of interest include undergraduate research, research literacy, and information seeking behaviors.



Kyoungsoo Lee, Assistant Professor of Physics, is an astrophysicist whose research interests include formation and evolution of galaxies in the young universe, the astrophysical processes governing star formation within galaxies, and the statistical association of galaxies and dark matter structures. Prof. Lee holds a BA from Pohang Institute of Science and Technology and an MS and PhD from Johns Hopkins University.

Francis Robicheaux, Professor of Physics, specializes in theoretical atomic, molecular, and optical physics. His specific research interests include time dependent atomic phenomena, highly excited (Rydberg) atoms, electron scattering, strong fields, and ultracold plasmas. Prof. Robicheaux joins the department from Auburn University and holds a BA, MS and PhD in physics from the University of Chicago.

Retired Faculty



Prof. Arthur Garfinkel
Years of Service: 1967-2012

Prof. Nicholas Giordano
Years of Service: 1979-2013

Staff Recognitions

College of Science Customer Service Award
Linda Paquay
Irena Ratkiene

College of Science Engagement Award
Tom Clifton

College of Science Leadership Award
George Jackson
Dennis Ritchie

College of Science Professional Achievement Award
Emjai Gregory
Ken Mueller
Keith Schmitter

CSSAC Clerical/Staff Excellence Award
Sandy Formica

Sandy Formica

Physics staff recognized at the College of Science Faculty & Staff Awards Luncheon (from left to right): Dept. Head Nick Giordano, Keith Schmitter, Ken Mueller, Dennis Ritchie, Irena Ratkiene, George Jackson, Linda Paquay, Emjai Gregory, Tom Clifton, College of Science Dean Jeff Roberts.

Physics INTERACTIONS

Graduate Research Focus

Kinetic Modeling of the X-ray-Induced Damage to a Metalloprotein

Kate Davis

It is well known that biological samples undergo X-ray-induced degradation. One of the fastest occurring X-ray-induced processes involves redox modifications (reduction or oxidation) of redox-active cofactors in proteins. Third generation X-ray synchrotron sources and newly constructed X-ray free electron lasers (XFELs) allow for new types of measurements to analyze the structure and function of biological molecules. However, the associated increase in X-ray flux and the rate of X-ray dose deposition exacerbates the problem of X-ray-induced damage to biological molecules and its effect on electronic and geometrical structures. One possible way to counteract this damage is to cool biological samples to cryogenic (preferably 10−20 K) temperatures. However, this currently routine approach prevents the analysis of dynamics such as electron transfer, conformational changes, and bond formations that occur in biological samples at room temperature (RT). Additionally, some intermediates escape cryogenic trapping because of extremely short lifetimes. In recent years, with the development of XFELs such as the Linac Coherent Light Source (LCLS – located at Stanford), it was proposed that the collection of data with sufficiently high time resolution would overcome X-ray damage. The concept is that by utilizing setups with high time resolution, we can always define some time window for data collection before X-ray-induced damage occurs. While plausible from both a physical and chemical standpoint, it needs experimental validation.

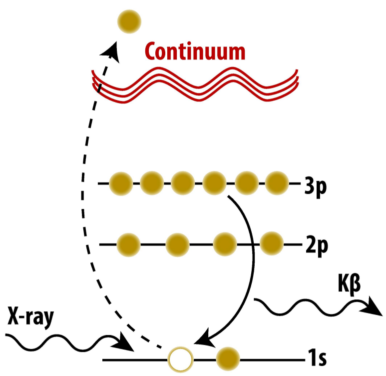


Figure 1: Process of XES

Damage studies in the Pushkar lab have focused on photosystem II (PSII) – the photosynthetic metalloprotein complex that splits water during photosynthesis in plants, green algae, and cyanobacteria – due to its high sensitivity to X-ray-induced damage. The oxygen-evolving complex (OEC) of PSII contains a Mn_4Ca core. In the active protein, the Mn centers are present in both Mn^{IV} and Mn^{III} oxidation states. X-ray-induced damage to PSII manifests in the reduction of Mn centers to Mn^{II} and breakage of Mn-O bonds. Recently, we demonstrated a methodology allowing for RT data collection capable of monitoring OEC state transitions with high time resolution. We used kinetic modeling to extract the rate of reaction of the OEC Mn core with free radicals generated in solution. The developed model can be further verified by analyzing damage kinetics observed with higher/lower rates of dose deposition as well as with the use of different excitation wavelengths.

We monitor the progression of X-ray-induced damage to PSII via Mn Kβ X-ray emission spectroscopy (XES). XES involves the excitation of an inner shell electron into the continuum and subsequent repopulation of the newly created hole. Kβ emission lines correspond to 3p→1s transitions, Figure 1. The Kβ spectrum is less intense than other transitions, but it has higher sensitivity to the electronic structure of the Mn center because of the exchange interaction between the 3p and 3d orbitals. The position of the more intense $K\beta_{1,3}$ peak is often used to determine changes in oxidation state, Figure

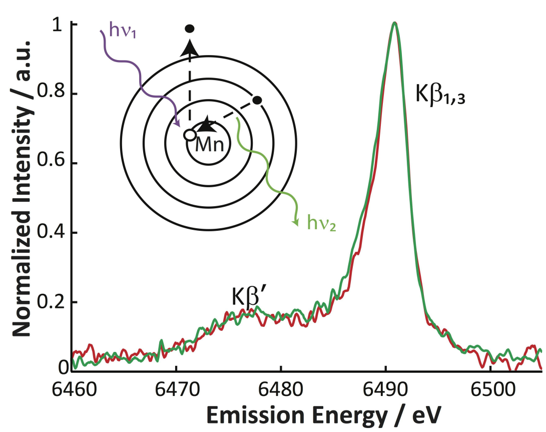


Figure 2: Normalized undamaged PSII XES data

2. As the oxidation state decreases, more electrons are present in the 3d level, increasing the valence spin, and leading to a greater exchange interaction (increased splitting) between 3d and 3p. Thus, if considering only the K$\beta_{1,3}$ peak, it appears to shift to higher energies with the reduction of Mn ions. We use this shift to monitor the extent of X-ray-induced photoreduction to the Mn cluster.

Utilizing previously collected undamaged XES data, we created calibration spectra composed of a chosen ratio of these data and XES of Mn^{II} in solution. These spectra then served as a comparison to the collected data for determining the percent reduction to Mn^{II}. Because of the low dilution of our target metal ions, it is highly unlikely that direct absorption by Mn and the creation of Auger electrons (less prevalent for heavier elements such as Mn) is the main source of damage. Instead, we hypothesize that absorption into the bulk sample (approximated as water) and subsequent radiolysis of water creates radicals whose interaction with the probed species dominates RT X-ray damage in biological samples. Aqueous electrons, e_{aq}, and hydroxyl radicals, $OH^{\bullet}$, are the most prevalent and reactive species created through water radiolysis, but given $OH^{\bullet}$ is a highly oxidizing species, we propose e_{aq} to be the main contributing radical.

We assume the rate of radical production is 0th order, and the "decay" of e_{aq} is a 1st-order reaction. The rate equations for a reaction of the OEC with radicals are written as

$$\frac{d[S_1(t)]}{dt} = k_2 [S_1(t)][rad(t)] \tag{1}$$

and

$$\begin{aligned} \frac{d[rad(t)]}{dt} &= r_c - r_d - r_r \\ &= r_c - k_1[rad(t)] - k_2[S_1(t)][rad(t)] \end{aligned} \tag{2}$$

where $[S_1(t)]$ represents the concentration of undamaged Mn (Mn^{IV} and Mn^{III} ions) in the S_1 state of PSII, [rad(t)] the concentration of radicals, k_1,and k_2 are the rate constants associated with e^-_{aq} decay and the radical-Mn ion interaction respectively; r_c, r_d, and r_r represent the rates of radical creation, decay, and interaction with S_1, respectively. We determine r_c iteratively throughout the thickness to account for attenuation. To account for the presence of the Mn^{IV} ions, requiring two electrons to reduce to Mn^{II}, we multiply the initial concentration of undamaged Mn by 1.5. The $[S_1(t)]$ data is most easily displayed as a percentage of Mn^{II} accumulated in the sample, see Figure 3. To fit the experimental data, we use the equation

$$\%Mn^{II} = 100\,(1 - e^{-k_2 R(t)}) \tag{3}$$

These fits yield the weighted mean rate constants k_1=4.0x10^7 s^{-1} and k_2=17.1 μm^3/(#radicals•s) yielding a lifetime for aqueous electrons of τ = ~2.5x10^{-8} s in the PSII sample. According to Cercek & Cercek (1973), the aqueous electron has a lifetime τ = ~4.5x10^{-8} s in protein-enriched environments at room temperature, lending credibility to model values for k_1 and k_2.

Assuming the rate constants (k_1 and k_2) are independent of flux, we can use the model to predict

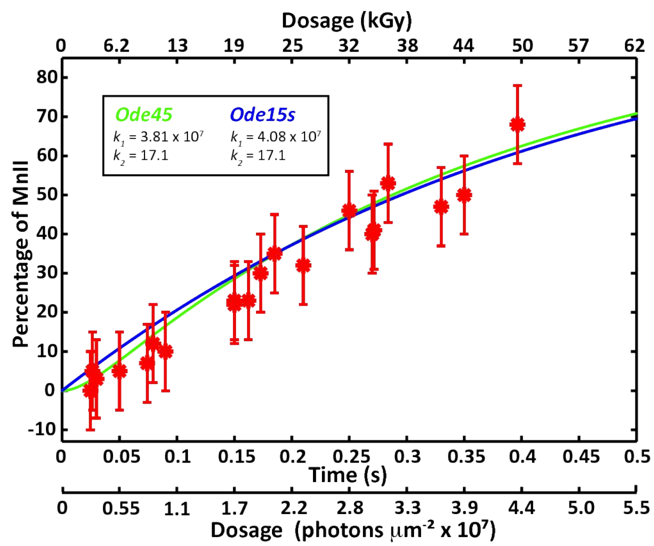


Figure 3: Fits to XES damage progression curve values for k_1 and k_2

damage progression with different rates of dose deposition. For example, we consider the application of our model to the vastly higher dose rates achievable at new x-ray FEL sources such as the LCLS. According to our model, the exposure time to reach 5% damage in the Mn oxidation state is ~1ps for a single pulse at LCLS. This indicates a dose limit of 10^{10} photons/μm^2 for a 10 μm sample thickness. The 1ps damage time is longer than the 100fs data collection time, implying that even higher number of photons can be used within a single LCLS pulse. However, caution should be exercised in case other physical/chemical processes become significant with such ultra-high rates of dose deposition.

*Ms. Davis is advised by Prof. Yulia Pushkar. For more information, see Davis K.M. et al., J. Phys. Chem. B, **2013**, 117, 9161-9169. This work is supported by the Department of Energy, National Institutes of Health, and the National Science Foundation.*

Faculty Research Focus

Cosmic Jets Powered by Supermassive Black Holes

Prof. Matthew Lister

Astronomers have found that deep in the heart of virtually every galaxy, including our own, lies an enormous black hole with a mass of several million to several billion Suns. Despite its huge gravitational potential well, under certain conditions the central black hole can actually cause large quantities of material to be ejected from the host galaxy at near light speeds. The most powerful outflows take the form of highly focused jets, and can propagate up to a million light years before disrupting into spectacular plasma plumes. The launching mechanism involves a complex interplay between a rotating accretion disk, its magnetic field, and the black hole's rotational and gravitational influence on local space time. Numerical simulations have made considerable inroads in understanding individual stages in the launching process, but reproducing it from start to finish still remains an enormous computational challenge.

Prof. Matthew Lister's research group at Purdue is focused on observational studies of these powerful jets to determine basic properties such as their speed, composition, and magnetic field structure, in order to provide essential constraints for numerical jet simulations. Their work capitalizes on the fact that the jets are extremely energetic, emitting photons from radio wavelengths to TeV gamma-rays, while producing roughly 100 times the energy output of our entire Milky Way galaxy. Also of huge benefit is an important aspect of special relativity: since the emitting jet plasma is moving at near-light speed, its radiation is highly beamed in the forward direction in our frame, thus boosting its apparent luminosity by a factor of up to a million if the jet happens to be pointing directly at us. This same relativistic Doppler effect also drastically shortens and amplifies any intrinsic variations in the jet's light output, causing rapid flaring events.

One of the most effective ways to probe the physics of these outflows is to directly image them using radio interferometers. The jet plasma is highly relativistic and magnetized, and thus produces copious quantities of synchrotron radiation that is easily detectable by modern radio telescopes. Unfortunately, the long wavelengths of radio waves make for very poorly resolved images, however this can be overcome by combining signals from numerous radio telescopes that are spaced very far apart. Individual pairs of telescopes provide information on the Fourier components of the sky brightness distribution, which are then inverted using computer algorithms to produce an image with a resolution comparable to a

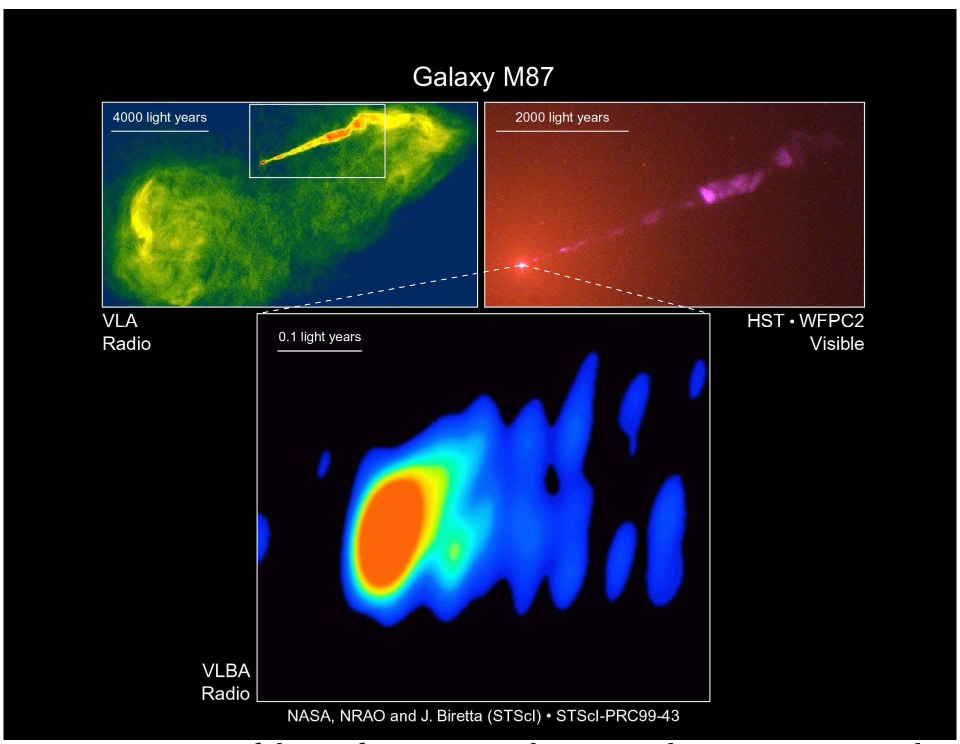


Figure 1: Images of the jet from M87 in the Virgo Cluster at successively higher resolutions as seen by the Jansky Very Large Array (top left), Hubble (top right), and the Very Long Baseline Array (bottom). (Image credit: Hubblesite.org)

giant diameter telescope. One of the premier instruments in this regard is the Very Large Array, located in Socorro, NM, which has a maximum telescope spacing of 36 km, yielding images with sub-arcsecond resolution (comparable to the Hubble telescope, see Figure 1). Prof. Lister's research program makes extensive use of this telescope, as well as The Very Long Baseline Array, which has telescopes spread across the U.S. from Hawaii to the Virgin Islands, and can thus achieve much finer detail, down to sub-milliarcsecond resolution. At these angular scales, which roughly correspond to the apparent size of the Apollo 11 lander as seen from Earth, it is possible to see structural changes in jets on timescales of months, despite the fact that they are several billion light years distant.

Prof. Lister heads up an international astrophysics collaboration named MOJAVE, which has produced time lapse movies of all the brightest jets in the northern sky. With the extraordinary image precision provided by the Very Long Baseline Array, the program has revealed that even on scales of up to hundreds of light years from the black hole, the jet outflows are not fully organized. In this region they undergo sudden accelerations, recollimation shocks (akin to standing waves), and collimation, in stark contrast to further down the jet, where the flow becomes much more ordered. Magnetic fields undoubtedly play a strong role in governing the dynamics of the relativistic plasma flow, and MOJAVE has carried out the largest jet imaging studies of linear and circular polarization to date. The degree of linear polarization in the radio images yields information about the field order, while the total intensity spectrum, electric vector directions, and circularly polarized emission tell us about the field strength and orientation. The field order generally increases down the jet, and in several nearby jets we see evidence for a helical field structure. The latter is expected from numerical simulations in which field lines co-rotating with the accretion disk and black hole Kerr metric get wrapped up into a twisted structure, allowing plasma to be accelerated out along the black hole spin axis. Work is also ongoing in an effort to use circular polarization information to determine whether the plasma is electron-proton dominated, or possibly comprised of electron-positron pairs.

The large breadth of the MOJAVE survey has also led to some serendipitous discoveries, such as a rare multiple imaging event in a jet whose line of sight passes through the plane of our galaxy. During several MOJAVE observations with the Very Long Baseline Array, a cold gas cloud in our galaxy about the size of Mercury's orbit passed in front of the jet, refracting its light and temporarily causing a triple image to appear. A similar phenomenon is frequently witnessed at northern latitudes when the Sun is near the horizon and there are ice crystals suspended in the upper atmosphere – the crystals refract the sunlight and create'ears' or 'sundogs' on either side of the Sun. In the case of extragalactic jet refraction, such a phenomenon had been predicted in the 1970s, but this marked the first time it has actually been imaged. An analysis of the MOJAVE data by collaborator A. Pushkarev of the German Max Planck Institute for Radioastronomy has revealed that the cloud lies approximately 5000 light years away, and has an electron particle density of only 4 x 104 cm-3 (a near-vacuum by Earth standards!).

The MOJAVE program is currently investigating a longstanding mystery regarding a population of jets detected by NASA's Fermi observatory at gamma-ray energies of approximately 1 GeV. Apart from our galactic plane, the gamma-ray sky is dominated by jets (Figure 2, front cover), and several of the brightest ones show extremely rapid variations at these energies, sometimes doubling their light output on timescales of minutes. Causality arguments suggest that in order for such a bright source to vary so rapidly it must either be physically very small, or highly Doppler beamed. In the former case, however, the source would be expected to undergo vast amounts of electron-positron pair-production, which would allow very few gamma-rays to escape. Most experts thus believe that the Doppler factors (and therefore jet speeds) must be very large, yet in these particular jets very few structural changes are seen in radio time lapse images. Purdue physics professor Maxim Lyutikov and Prof. Lister have proposed a model in which the jet flow is intermittent, creating a highly relativistic, thin 'breakout' region that is responsible for the gamma-ray emission, whereas the radio emission comes from the slower region behind it. With the data currently being gathered by MOJAVE on the largest sample to date of these jets, it should be possible to test this theory and other competing models for these highly energetic phenomena.

Prof. Lister's research is supported by a NASA Fermi Guest Investigator Award. More information on the MOJAVE program can be found at http://www.physics.purdue.edu/MOJAVE.

Graduate Student Awards

Outstanding Graduate Student Teacher
Jordan Heim
Daniel Merrill

AAPT Outstanding Teaching Assistant
Jordan Heim

Akeley-Mandler Award for Teaching Excellence
Cyrus Vandrevala

Gabriele F. Giuliani Award
David Blasing

George W. Tautfest Award
Qiuguang Liu

H.Y. Fan Award
Dooshaye Moonshiram

Karl Lark-Horovitz Award
Brandon Johnson

Lijuan Wang Award
Dooshaye Moonshiram
Li Yi

Bilsland Dissertation Fellowship
Ran An
Sourav Dutta

Graduate student **Ran An** led a team that won $30,000 in the 26th Burton D. Morgan Business Plan Competition, hosted by Purdue University's Discovery Park. The science behind the plan, tissue dynamics spectroscopy or TDS, was featured in the 2012 Physics Interactions newsletter. Within each patient, the protein profile of any cancer is unique and can also vary significantly from tumor to tumor and even within tumors. TDS is a new approach that tailors the selection of anticancer drugs for individual patients by measuring the collective motions of the components of cells inside living tissue.

Ran An presenting at the Burton D. Morgan Business Plan Competition (Purdue University photo/John Underwood).

Undergraduate Student Awards

Bottorff Physics Scholarship
Jacob Connor
Benjamin Fasig

Shalim and Paul Sargis Memorial Scholarship
Jonah Polley

David G. Seiler Physics Scholarship
Jennifer Larson

Kenneth S. and Paula D. Krane Scholarship
Samuel Higginbotham
Lauren Kolkman
Rui Zhang

AAPT Outstanding Learning Assistant
Sean Fancher

College of Science Outstanding Student Award
Taylor Erwin (Fr)
Bennett Marsh (So)
Joshua Knobloch (Jr)
Brent Woodhouse (Sr)

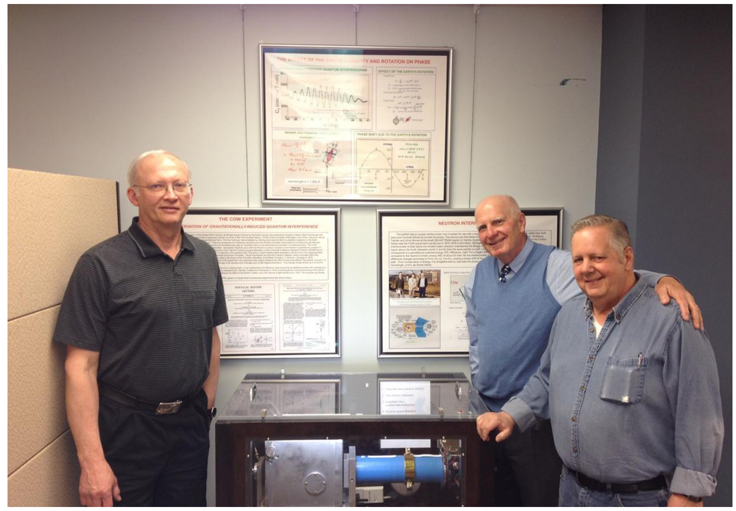
Richard W. King Award
Joshua Knobloch (Jr)
Brent Woodhouse (Sr)

Judith Peters Humnicky Memorial Award
Rebecca Weirauch

Spira Summer Research Award
Benjamin Fasig
Joshua Knobloch

Overhauser Memorial Lectures

The Physics Department remembered the career of Professor Albert Overhauser (1925-2011) on April 16-17, 2013. The 2-day event featured reflections by Prof. Sam Werner (NIST, University of Missouri), Prof. Tony Arrott (Virginia Commonwealth University), and Prof. John Hopfield (Princeton University), on Al's contributions to science and his role as a mentor. At the Department reception for the speakers and the Overhauser Family, the Physics Library unveiled a display commemorating the COW experiment. The experiment, performed by Prof. Robert Colella, Overhauser, and Werner, was the first recorded observation of gravitationally induced quantum interference. Also during the event College of Science Dean Jeffrey Roberts announced that Professor Chris Greene was named the Albert Overhauser Distinguished Professor of Physics.



COW Neutron Interferometry Experiment Display in the Physics Library. Pictured (left to right) are the display designers: Mark Smith, Sam Werner, and Tom Halsmer.

Pictured (left to right): Al Overhauser, Roberto Colella, and Sam Werner in 1974.

Tony Arrott

John Hopfield

Sam Werner

Hubert James Lecture

Theodor Hänsch, Director of the Max Planck Institute for Quantum Optics and Carl Friedrich von Siemens Professor of Physics at Ludwig-Maximilians University, gave the 21st annual Hubert James Memorial Lecture on October 31, 2013. He received the Nobel Prize in Physics in 2005 for "contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique."

2013 Honorary Doctorate

Purdue University awarded Dr. David S. Leckrone an Honorary Doctorate at its Spring 2013 commencement exercises.

Dr. Leckrone worked as an astrophysicist at NASA's Goddard Space Flight Center for 40 years. From 1992 to 2009, Dr. Leckrone served as senior project scientist for the Hubble Space Telescope (HST). He provided scientific leadership for all aspects of the Hubble program, including program management, spacecraft and science operations, development of new scientific instruments and in-orbit servicing. Leckrone also had overall project responsibility to assure that the scientific performance requirements for the Hubble observatory were achieved and that the HST observatory remained scientifically productive and successful over its long lifetime. Leckrone was the lead scientist for five highly successful Space Shuttle servicing missions to Hubble. Dr. Leckrone was also head of the Astronomy Branch in the Laboratory for Astronomy and Solar Physics at Goddard from 1981 to 1991. Dr. Leckrone earned a bachelor's degree with honors in physics from Purdue in 1964 and a PhD in astronomy from UCLA in 1969. He holds an MAS in Management degree from Johns Hopkins University, awarded in 1987. In January 2012, the American Astronomical Society awarded Leckrone the George Van Biesbroeck Prize in recognition of "long-term and unselfish service to astronomy." In 2009, he received the NASA Distinguished Service Medal, the highest honor the agency bestows on a civil servant. He was a recipient of the U.S. Presidential Rank Award of Merit in 2008. Leckrone retired from NASA in 2009. He and his wife, Marlene, reside in Silver Spring, Maryland. He has a son, daughter and two grandchildren.

2013 Distinguished Alumni Award

The Department of Physics and the College of Science honored Dr. Roger Dixon as its 2013 Distinguished Alumnus on April 12, 2013.

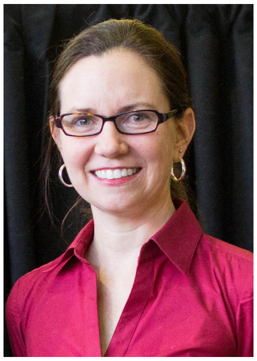
Roger L. Dixon (MS 1972, PhD 1975)

Roger Dixon is the Head of the Accelerator Division at Fermilab where he has been on staff since 1977. His other assignments at Fermilab have included Head of the Switchyard Group in the Accelerator Division, Deputy Head of the Tevatron II Project, Head of the Experimental Areas Department, and Head of the DØ Department. As a researcher, he has worked on the Cryogenic Dark Matter Search, serving as project manager from 1998 to 2003, and the DØ experiment, a study that led to the first observation of the top quark. In addition to his research roles, Dr. Dixon has organized Fermilab's Saturday Morning Physics program for high school students since 1998.

2013 Outstanding Alumni Awards

The Physics Department and the College of Science hosted the 2013 Outstanding Alumni on October 11, 2013.

Kara Hoffman (PhD 1998)



Dr. Kara Hoffman was raised in Lexington, KY and received her B.S. degree in physics from the University of Kentucky in 1992. Under the direction of Professor Daniela Bortoletto, she completed her doctoral research on searches for new particles at the Collider Detector at Fermilab in 1998. She then moved to Geneva, Switzerland as a fellow at CERN where she worked on the OPAL experiment at the Large Electron Positron Collider. She returned to the U.S. as a research associate at the University of Chicago. In 2004, she left Chicago to commence a tenure track position at the University of Maryland, where her research has focused on high energy neutrino astrophysics. She was granted tenure in 2010 and currently serves as the director of the Center for Experimental Particle Physics at the University of Maryland.

John Monnier (BS 1993)

John Monnier received his B.S. in Physics from Purdue University in 1993 and subsequently attended graduate school at the University of California at Berkeley. After receiving his Physics PhD in 1999 working with Professor Charlie Townes and Dr. William Danchi on novel astronomical instrumentation, Dr. Monnier was awarded a Harvard-Smithsonian Center for Astrophysics Fellowship where he led an effort to observe planet-forming disks around young stars using the technique of optical interferometry. In 2002, Dr. Monnier began a faculty job at the University of Michigan Astronomy Department, where he continues to build optical and infrared instruments, most notably the first interferometric combiner capable of imaging the surface features on nearby stars.

Alumni News

Nathan Cooper (PhD 2010) has been inducted as a Fellow of the Academy for Teachers and has been selected by the American Astronomical Society to serve as an Astronomy Ambassador.

John Parker (PhD 1988) was appointed as an Assistant Professor of Physics at Lewis University.

Nicholas Giordano (BS 1973) was named Dean of the College of Science and Mathematics at Auburn University.

D. Michael Stretchberry (BS 1962) has enjoyed his time as a docent at the Denver Art Museum for 23 years where he has given more than 1,200 tours for about 43,000 adults after obtaining masters degrees in physics and economics.

In Memorium

Paula Feuer (PhD 1951)

Have news to share? Send it to us?

From the Director of Development

While only a member of the Physics department since January, I have had the honor and privilege of meeting several fascinating and generous alumni in this short time. I am consistently amazed by the warmth and sense of gratitude shared with me on visits across the country. Purdue Physics clearly holds a very special place in your hearts. As a group, by percentage of graduates, you are more generous with your treasure than any other department in the College of Science. The same demand for excellence seen in your college years remains today and we continue to try to recruit the best and brightest students. To do this, we need scholarships, fellowships and professorships. Annual giving helps as well, because these funds are unrestricted and can be used at the discretion of the department head. No matter the size or designation of your gift, please be assured that it is appreciated and will be used to continue the legacy of excellence that is Physics at Purdue!

Hail Purdue,
Christy Harrison, ‘90
Director of Development

Physics Degrees

December 2012 - August 2013

Bachelor of Science

Austin Beidelman
Ross Caton
Alexander Chen
Ian Christie
Johnson Chu
Sean Fancher
Yuedong Fang
Jonathon Foster
John Frantonius
Rachael Fulper
Jessica Green
Maxwell Gubler
Akira Kashiwa
Ryan Kelly
Amanda Kollak
Christopher Kraner
Geoffrey Lentner
Christopher Majors
Alexander McRitchie
Hooram Nam
Daniel Pincetich
Jorge Ramos
Justin Ruiz
Micah Snabl
Dane Snyder
Christopher Soverns
Joseph Street
Adam Szewciw
Brent Woodhouse
Edward Yates
Sai Zhang
Chengliang Zhu
Aaron Zimmerman

Master of Science

Ian Arnold
David Blasing
Mayra Cervantes
Brianna Dillon
Jordan Heim
Dustin Hemphill
Michael Meier
Jacques Pienaar
Justin Sheek
Yanfei Shen
James Tucci

Doctor of Philosophy

Edwin Antillon
Jayprakash Bhosale
Helin Cao
Adrien Chauvet
Kari Frank
Junyan Ge
Andrew Irrgang
Joshua Konzer
Hochan Lee
Wan-Ju Li
Xin Li
Qiuguang Liu
David Lomiashvili
Suzanne Lorenz
Joshua Mattes
Mustafa Mustafa
Christopher Petrovitch
Benjamin Phillabaum
Nodar Samkharadze
Shukun Shi
Wendi Wampler
Daniel Whitenack
Xuefeng Yuan
Yu Zheng
Xiaoting Zhou
Sannah Ziama

Congratulations to our newest alumni!

Recognizing Our Donors

We recognize and thank our alumni and friends who made gifts to the Department of Physics in fiscal year 2012 (July 1, 2012 - June 30, 2013).

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Did You Know?

Adam Szewciw (BS 2013) was selected to be the student responder at Purdue's August 2013 commencement.

Physics INTERACTIONS

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