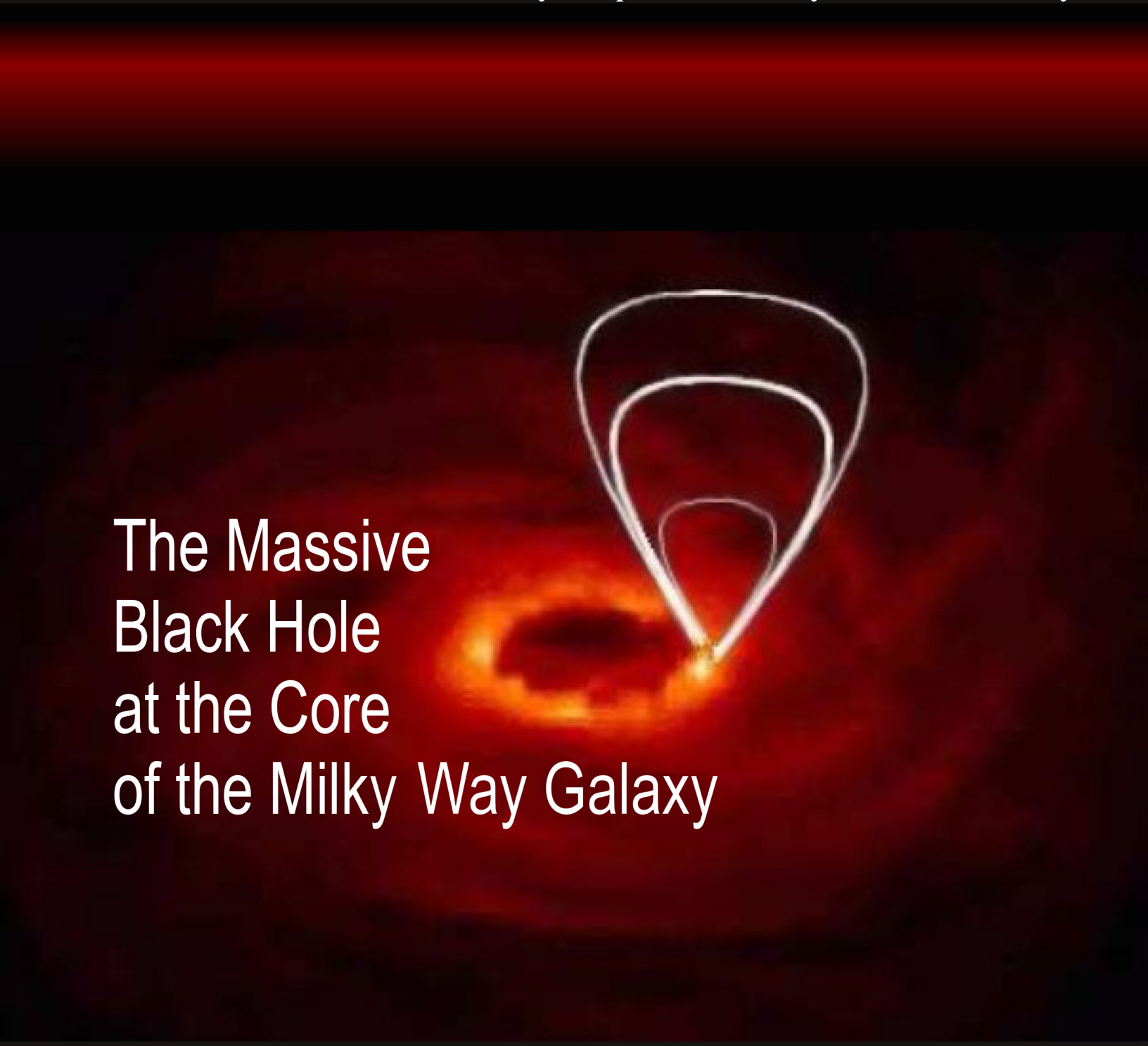
Dimensions

Spring 2009

Northwestern University's Department of Physics and Astronomy



The Massive Black Hole at the Core of the Milky Way Galaxy

CONTENTS

The Massive Black Hole at the Core of the Milky Way Galaxy

by Farhad Yusef-Zadeh
Professor of Physics

1. History

The United Nations has dedicated 2009 as the International Year of Astronomy in order to celebrate the 400 year anniversary since Galileo turned his telescope to the night sky and increased the human eye sensitivity by a factor 16. Among numerous discoveries, Galileo found four moons orbiting Jupiter which reinforced the Copernican picture of the solar system. Four hundred years later, ten-meter class telescopes with adaptive optics are turning toward the center of the Galaxy in order to follow the orbit of stars revolving around a dark concentrated mass. Observations of the orbital parameters of several stars, including one with a 15-year orbital period, have already given the most compelling evidence for a four million solar mass black hole at the dynamical center of our Galaxy. No other known category of astrophysical object can easily fit so much mass into a sub-AU-size region (AU is the average distance between the Earth and the Sun).

The driving force for these discoveries involves technological advances, allowing diffraction limited spatial resolutions as well as a sensitivity increase from a factor of 16 at the time of Galileo to 25,000 in today's observations. Another technologically driven discovery was made by Karl Jansky from Bell Labs. In 1932, Jansky built a 14.6 meter antenna operating at 20 MHz and detected a strong radio signal from the direction of the Milky Way core. A whole new field of radio astronomy began. The follow-up radio interferometric observations identified a strong radio source (called Sagittarius A* or SgrA*) at the core of the Milky Way coincident with the black hole. Sir Marin Ryle was awarded the Physics Nobel price in 1974 for his invention of radio interferometry and many believe that Karl Jansky would have also won one, had he lived longer.

The massive black hole SgrA* is a hundred times closer to us than the next nearest example, presenting an unparalleled opportunity to closely study the process by which gas is captured by black holes. It is therefore the subject of intense scrutiny. The energy radiated by Sgr A* is thought to be liberated from gas that is falling into the black hole after being captured from the powerful winds of members of its neighboring cluster of massive stars. The total luminosity (energy/s) of SgrA* is several orders of magnitudes below that predicted given its expected rate of capture of material from stellar winds prompting a number of theoretical models to explain its very low efficiency.

In spite of numerous theoretical studies to explain the steady component of the emission from SgrA*, it is still not clear why SgrA* is so under-luminous. Attention has now turned to the variable component of its emission in multiple wavelengths. *What is really exciting is that we are beginning to peer at the closest supermassive black hole in multiple wavelengths, and are discovering rapid, correlated variability that likely stems from gas dynamical flow and radiation very near the hole.*

About the Author:


Farhad Yusef-Zadeh

Farhad Yusef-Zadeh is a Professor of Physics at Northwestern University. He attended SUNY at Stony Brook for his undergraduate studies in Physics, then attended Columbia University for his PhD in Astronomy in 1986. He spent two years at NASA's Goddard Space at the Flight Center working as a National Research Council postdoctoral fellow before joining the faculty of the Department of Physics and Astronomy at Northwestern University in 1988. Farhad's main interest is to understand the physical processes that take place in the nucleus of our galaxy, the nature of supernova remnants interacting with molecular clouds, and star formation.

2. Observing Campaigns

In the last several years, we have been coordinating a number of telescopes in order to understand the correlation and the radiation mechanism of flare emission in different wavelength bands. Here, I highlight

Cover — A schematic diagram of blobs expanding away from a disk is superimposed on a simulated image of the synchrotron emission from the central 16 Schwarzschild radii (i.e., the event horizon). The brightest area of this disk model comes from the region near the last stable orbit.

the results of observations made during 2007 April 1-11. This international collaboration involved eight countries and more than twenty different institutions. This observing campaign involved the coordination of 13 observatories which included three satellites in X-ray (XMM-Newton), γ-ray (INTEGRAL) and near-infrared (Hubble Space Telescope) bands as well as numerous radio and submillimeter telescopes. The results from these measurements are highlighted below.

2.1. Infrared, X-ray vs. Radio Flare Emission

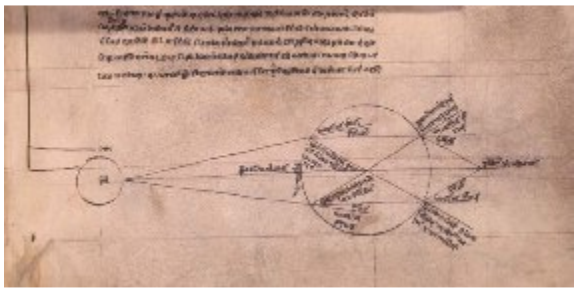
Figure 1a shows the flux of SgrA* as a function of time (e.g., light curve) obtained with radio, infrared and X-ray telescopes on 2007, April 4. These light curves show that the strong flares in X-rays and infrared wavelengths are coincident with each other with no time delay. However, the radio flare at 43 GHz detected between 10h and 15h UT is time delayed with respect to the peaks of infrared and X-ray flare emission. The time delay measurements readily indicate that radio flare emission is optically thick whereas the X-ray and infrared emission is optically thin. The light curves shown in Figure 1 are consistent with previous time delay measurements that we have made in several past experiments. The time delay between flaring events is consistent with a picture in which the synchrotron flare emission is optically thick. The intensity grows as the plasma expands, then peaks and declines at each frequency once the plasma becomes optically thin. This first occurs at highest frequencies and then at lower frequencies, hours to minutes later depending on the frequency separation. The adiabatic expansion picture of flaring activity of SgrA* considers plasma with a homogeneous sphere threaded by a uniform magnetic field. The cover figure shows a schematic diagram of this model. As the plasma expands from the disk, the relativistic particles cool by adiabatic expansion with $E \alpha 1/R$ and the magnetic field is diluted as $B \alpha R^{-2}$ because of flux freezing. One of the consequences of the adiabatic cooling of hot plasma is that optically thick gas should show a time delay as a function of frequency.

One of the key motivations of our observing campaign was to examine whether flare emission is tied to accreting gas onto the black hole or to outflowing material away from the black hole. *The presence of time delay in flare emission suggests clearly that hot plasma is expanding away from the disk, thus implying the outflow is responsible in reducing accreting material onto the black hole.*

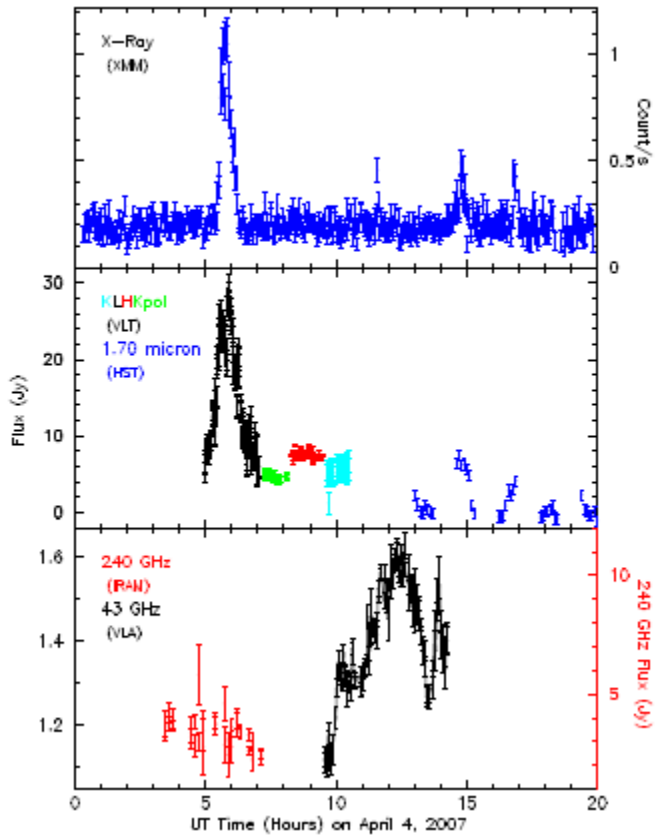
2.2. X-ray Emission Mechanism: Inverse Compton Scattering

Flaring X-ray emission from Sgr A* has been detected and has been argued to originate within a few Schwarzschild radii R_s (i.e., the size of the event horizon for a non-rotating black hole) of the α 4 × 10^6 solar mass black hole. Synchrotron flaring in the infrared can produce an X-ray flare by inverse Compton scattering. A proportion of the infrared photons emitted during the flare will be upscattered by the population of relativistic electrons in the disk of SgrA*. In this scenario – upscattering of infrared emitting photons are carried out by the quiescent population of electrons in the disk, as drawn schematically in Figure 2. To estimate the resulting inverse Compton flux, we adopt the properties of bulk electron population responsible for the quiescent emission that were inferred in a model-independent analysis. In the context that was discussed, inverse Compton scattering involves scattering of photons from low (infrared) to high energies (X-rays) by energetic particles of tens of MeVs. We conclude that the fluxes of the observed X-ray flares are broadly consistent with this inverse Compton scattering model.

The extent of the electron population in the disk may on occasion give rise to significant time delay between infrared flaring and their X-ray counterparts. A sufficiently energetic IR flare would lead to X-ray production by inverse Compton scattering on the extended ~ 1000Rs outer envelope of low-temperature electrons, producing weak post-main-flare X-ray emission lasting for tens of minutes after the main flare has subsided. *Detection of these "echoes" would confirm the scenario proposed here and help determine the size of the outer region which is rendered inaccessible to direct observation by the effects of interstellar scattering.*



Optical diagram showing light being refracted by a spherical glass container full of water, from Roger Bacon <http://en.wikipedia.org/wiki/History_of_the_telescope>



The light curves of SgrA* on 2007, April 4 obtained in X-rays (top), infrared (middle) and radio (bottom) bands.

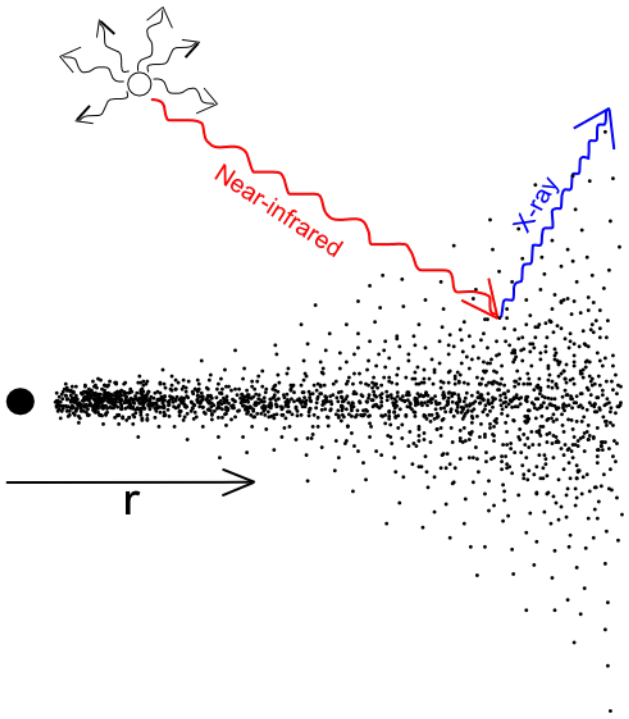
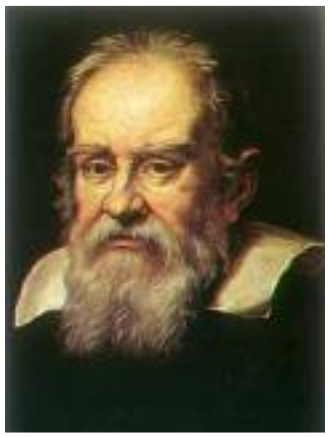


Fig. 2 — A schematic diagram of the inverse Compton picture for SgrA*.

Events

Dearborn Observatory Celebrates Galileo

by Michael Smutko, Senior Lecturer



Galileo Galilei

As part of the "International Year of Astronomy", celebrating anniversary 400 of Galileo's invention of the telescope, Dearborn Observatory held a special public viewing event on the evening of April 4, 2009. In addition to telescope viewing and webcasts from other observatories around the world, visitors were treated to talks and question-and-answer sessions from our faculty, post-docs, and graduate students describing the research going on at Dearborn. Visitors also had the chance to have their own questions answered on topics ranging from Pluto to Dark Energy. Despite the mostly cloudy skies, 185 people were able to see Saturn and the Moon and many others said that they planned to come back for one of our regular Friday evening public open houses.

The International Symposium on Quantum Fluids and Solids

will be held at Northwestern University August 5-11, 2009. The symposium will draw approximately 250 scholars and researchers from Europe, Asia and the Americas to Evanston to present their research on ultra cold atomic gases, liquids and solids, as well as quantum mechanical systems at low temperatures high magnetic fields - from macroscopic to nanometer length scales. URL: http://www.qfs2009.northwestern.edu/

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The Hang

by Andrew Morrison
Visiting Assistant Professor

The following is a summary of an article which Tomas Rossing of Northern Illinois University and I published in the March 2009 edition of Physics Today.

One of the most popular percussion instruments invented in the past decade is a hand-played steel instrument called the hang. The hang, a cousin of the Caribbean steelpan, has tuned notes which are struck by the performer's hands. (The word *hang* is a Bernese word for hand.) PANArt, the company responsible for the development of the instrument, has a long history of making steel instruments. The new instrument is held in the lap of the musician while played, and the performers favor the richness of the tone the instrument produces. But the hang also contains a wealth of interesting physics making for a rich study into the acoustics which are responsible for its unique sound.

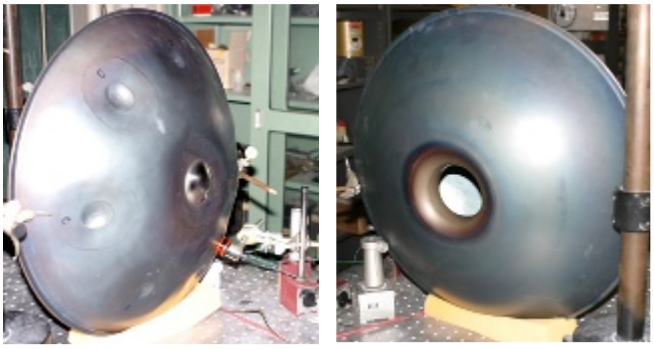


Figure 1: Top and bottom views of a hang. In the view of the top of the hang a coil is shown near the surface of the instrument. The coil is used to drive a tiny magnet on the instrument for modal analysis.

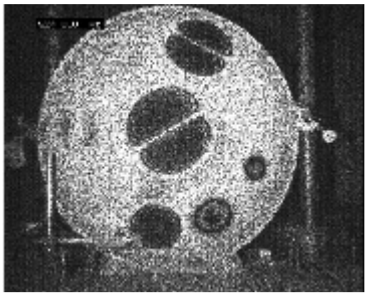


Figure 2: Holographic interferogram of a hang where the C_5 note (approximately at the 6 o'clock position) is driven at its fundamental frequency of 524 Hz. Note that the note C_4 note on the opposite side is excited near its second resonance and the F_3 note at the center is excited near its third resonance.

Figure 2 shows an interferogram of a hang being driven sinusoidally at 524 Hz on the C_5 note area. The note is approximately near the 6 o'clock position, and the driving coil is seen next to the note. The C_5 note at 524 Hz vibrates in its fundamental mode as characterized by the single circular lobed structure covering the entirety of the note. On the opposite side of the drum is the C_4 note which is vibrating in its second mode as characterized by a double lobed structure. The bass F_3 note is vibrating in its third mode, also characterized by a double lobed structure. The mode shapes of the second and third modes of each note are distinguished by the orientation of the nodal line which appears in the interferogram as a bright white line running through the note. There are also small vibrations around the 4 o'clock and 5:30 positions which are the $C^{\#}_5$ and $A^{\#}_4$ notes, respectively. The contributions of these notes at this frequency would be most significant at very high amplitudes. Compared to the vibrations of the other 3 notes, these two contribute very little.

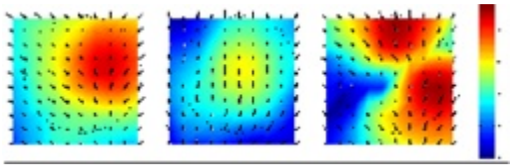


Figure 3: Active intensity for the first three modes of the A note on a high-voice hang. Color indicates relative magnitude of the intensity from lowest intensity in blue to highest intensity in red.

About the Author:

Andrew Morrison is a Visiting Assistant Professor of Physics at Northwestern University. He received his Ph.D in physics from Northern Illinois University in 2005. His interest in musical acoustics has led to studies of Caribbean steel pans, mandolins, balalaikas and the acoustics of the coffee mug.

Andrew Morrison

Figure 3 shows the active intensity for the first three modes of vibration of the A_4 note in a plane 8 cm above the top of the bass note area of a high-voice hang. The maps show how the sound radiates away from this note. The first two modes of this note exhibit monopole radiation, where the sound is radiated nearly uniformly away in all directions. The highest intensity for the first mode is centered over the note being driven, while the highest intensity for the second mode is located in the center of the instrument itself. The third mode shows a dipole radiation pattern.

Full article: http://scitation.aip.org/journals/doc/PHTOAD-ft/vol_62/iss_3/66_1.shtml

Students

Northwestern's Society of Physics Students (SPS)

by Colleen Moore, NU SPS President

This past year, Northwestern's Society of Physics Students (SPS) chapter hosted activities such as the annual Departmental Picnic, a graduate student panel, a variety of research talks, an art gallery along with participating in several outreach programs providing physics demo shows for SWE's annual Career Day for girls and Science Chicago: Neighborhood Science at NEIU. Fall quarter, we also participated in the SPS Congress at Fermilab and winter quarter several female undergrads attended the 2nd Annual Women in Physics Conference at UIUC.

Over the course of the next year, we will be actively pursuing several exciting long-term projects:

Design Competition: SPS will sponsor their own team to design a robot to complete a series in contention for glory on competition day in May. The designing process and building of the robot will take place during winter and spring quarters.

2nd Annual Physics Research Art Gallery: After the success of the art gallery this spring, we are ready to start planning next year's show! We will display submitted artwork from current physics and astronomy research in Tech Lobby. This event in particular provides a visual interpretation of what is new and exciting within the Department.

Public Science and Career Lectures: SPS received a grant from the Northwestern Alumni Association to host a larger scale lecture series, bringing in speakers from other institutions or industries to talk about their research and careers. We are in the planning stages for this winter.

Multi-Week Lab Based Outreach Program: Next year we want to design a curriculum appropriate for middle school students who are interested in science. The program would invite the students to spend a couple Saturdays at Northwestern, during which time they would work with different aspects of Lego Mindstorms sets. The curriculum will cover building mobile Lego robot, programming it to complete different tasks and exploring how the sensors (light, sound, motion, etc) work and the physics behind it all.

In addition to these long-term projects, SPS will continue to plan and host our typical activities: research talks from Northwestern professors, movie/social nights, lab notebook sales, SPS T-Shirt sales, and more. We welcome anyone with an interest in physics to attend our events! If you would like more information about any of the previously mentioned projects or if you would like to join our listserv and receive e-mails from SPS about our activities, please e-mail nwu.sps@gmail.com.

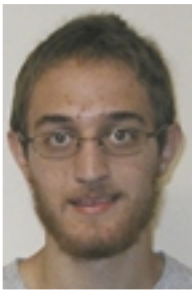
Northwestern's SPS Officers -
From Left to Right: John Liu (officer), Brandon Walker (vice president), Irina Patrikeeva (secretary/webmaster), Colleen Moore (president), Michael Tremmel (officer), Emery Goss (treasurer), Arthur Schmidt (faculty advisor)

Student Scholarships:

The Winston Churchill Foundation has awarded senior **Yoni Kahn** the Churchill Scholarship to pursue graduate studies at the University of Cambridge. Yoni Kahn of San Jose, California, is a senior majoring in physics, mathematics, and music performance with a minor in music composition. He was awarded the Josephine De Kármán Scholarship last spring in high energy physics. Out of the 12 recipients nationwide he was one of only two undergraduate winners. He studied at the École Polytechnique in France and spent a summer at the European Organization for Nuclear Research (CERN) in Switzerland.

Yoni Kahn

Zack Nicolaou has been awarded The Barry M. Goldwater Scholarship. The scholarship is awarded yearly to some of the most promising college students nationwide who intend to pursue careers as scientists, mathematicians, or engineers. Zack is a junior physics, mathematics and ISP major working with Prof. Motter on a research project funded by the MRSEC Academic-Year Undergraduate Research Program.



Zack Nicolaou

Senior Class Plans:

Jeff Andrews has been accepted into the PhD program at Columbia University, and he will pursue his PhD in Astrophysics.

Matt Bierbaum has been accepted into the PhD program at Cornell University, and he will pursue his PhD in Nonlinear Dynamics Physics.

Alexandra Cunliffe has been accepted into the PhD program at the University of Chicago, and she will pursue her PhD in Medical Physics.

Michael Dennison is working for Booz Allen Hamilton as an Energy Consultant in their System Integration and Technology division.

Julia Fang has been accepted into the PhD program at UCLA and she will pursue her PhD in Astrophysics.

Yoni Kahn has been accepted into the PhD program at the Massachusetts Institute of Technology, and he will pursue his PhD in Theoretical Physics. He has deferred entry into the program, as he works for a Certificate of Advanced Study in Math/Physics at the University of Cambridge.

James Kath has been accepted into the PhD program at the Harvard University, and he will pursue his PhD in Biophysics. He has deferred entry into the program for one year to participate in the Japan Exchange and Teaching (JET) Programme.

Grant Kettering has been accepted into the MA program at St. John's College and he will pursue his MA in the Liberal Arts.

Ellen Kletscher will be working for the Department of Defense as an Architect.

Ryan Murphy has been accepted into the PhD program at Washington University, and he will pursue his PhD in Physics.

Benjamin Rolfs has been accepted into the PhD program at Stanford University, and he will pursue his PhD in Computational and Mathematical Engineering.

Kent Shirer has been accepted into the PhD program at the University of California at Davis, and he will pursue his PhD in Experimental Condensed Matter Physics.

Graduate Student Milestones:

Lou Jisonna, working with Ralph Segel, has successfully defended his dissertation, "Breakout Reactions from the CNO-cycle". He is now working as a post-doctoral fellow in Physics at Hope College in Holland, Michigan, where he teaches and works as a researcher in the Nuclear Group.

Ljubomir Miljacic, working with Don Ellis, has successfully defended his dissertation, "Hybrid methodologies for modeling the dynamics in selected classes of materials". He is now working as a postdoc at Caltech, with Prof. Axel van de Walle.

Derek Strom, working with David Buchholz, has successfully defended his thesis, "Study of CP Violation in Neutral Bs decays to J/Psi Phi Decays at D0". He has accepted a postdoc position at the University of Illinois at Chicago. He will be working on the high energy physics experiment CMS at CERN's LHC.

Wanling Xu, working with John Ketterson, has successfully defended her dissertation, "Assembly of Ordered Microsphere Arrays: Platforms for Microarrays". She is working for Citigroup in New York as Financial Associate.

Sung Woo Youn, working with David Buchholz, has successfully defended his, "Measurement of the branching ratio of neutral Bs decays to Ds Ds and the Lifetime Difference in the Bs System". He has accepted a postdoc position at the Fermilab. He will continue working on Fermilab's D0 experiment.

SPS wins award from the Alumnae Board of Northwestern University Gifts and Grants Committee

The Society of Physics Students (SPS), the Department's undergraduate student association, has been awarded a $1,250 grant from the Alumnae Board of Northwestern University. The funds will be used to support a new lecture series during the 2009/2010 academic year. SPS plans to invite speakers from the Chicago area and beyond to give lectures at Northwestern which will be open to the University and the public. In requesting support for the lecture series, SPS hoped to fill a perceived need for public talks that will be accessible to people without a deep technical background, exploring both physics research and career possibilities in physics. In addition to lectures, SPS plans to host lunch gatherings to give undergraduate students the opportunity to interact directly with speakers.

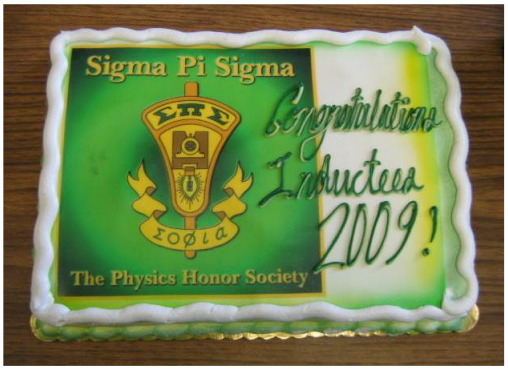
The Alumnae Board is a volunteer organization, founded in 1916, that has given over four million dollars to the University community over its existence. The award to SPS was funded by their Continuing Education Program.

Hubble Space Telescope

2009 Sigma Pi Sigma Induction ceremony (June 3, 2009)

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 till 1986. Since then it has had an Installment Ceremony every year with membership now numbering 160.

Dr. Arthur Schmidt presents a certificate to the newest student members: Matthew Keenan Bierbaum, Benjamin Thomas Rolfs, Jeffrey John Andrews, Alexandra R. Cunliffe, Ellen Marie Kletscher, Ryan Patrick Murphy, Michael Allen Dennison, Alexander Edwards Carter, Eric Jeffrey Pei, Zachary George Nicolaou, and Brandon Joseph Walker.



Faculty

Honors:

Venkat Chandrasekhar was elected a Fellow of the American Physical Society.

André de Gouvêa was promoted to the rank of Associate Professor with tenure. André's research efforts are concentrated on addressing the questions raised by the experimental neutrino data collected over the past five years which clearly show that the Standard Model of Particle Physics is, at the very least, incomplete.

Vicky Kalogera was elected a Fellow of the American Physical Society in 2008 for fundamental contributions to understanding the structure, formation and evolution of compact objects in binary systems, using X-ray and radio observations to study their importance for gravitational wave detectors.

Vicky Kalogera was promoted to the rank of Full Professor. She is interested in the physics of compact astrophysical objects: white dwarfs, neutron stars, and black holes.

Prem Kumar was among the 32 new AAAS Fellows affiliated with the Section on Physics elected in November 2008. AAAS defines a Fellow as "a Member whose efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished." Prof. Kumar was recognized "for distinguished contributions to the science and technology of quantum communications, particularly for utilizing quantum optical effects in fibers to realize applications of entangled photons."

David Meyer was named the Charles Deering McCormick Professor of Teaching Excellence.

Adilson Motter won the 2009 Weinberg Award for Excellence in Mentoring Undergraduate Research. The award recognizes a faculty member who has established a history of exceptional work with undergraduate students and the development of opportunities for them to become involved in research and other sustained creative projects.

Adilson Motter was selected as an Alfred P. Sloan Research Fellow. The award is given annually to 118 early career scientists who demonstrate outstanding promise and potential to contribute substantially to their fields.

Andy Rivers was named to the Association of Student Government Faculty Honor Roll.

James Sauls was an Erasmus Mundus Lecturer on Nanoscience and Nanotechnology in Modern Society. at the Department of Microtechnology and Nanoscience, Chalmers Technical University, Göteborg, Sweden, February 1-28, 2009.

Selim Shahriar has been elected a Fellow of the SPIE (International Society for Optical Engineering).

Mike Smutko was named to the Association of Student Government Faculty Honor Roll.

Selected Publications:

Pulak Dutta

"Effects of chitosan on the morphology and alignment of calcite crystals nucleating under Langmuir monolayers", Kyungil Kim, Ahmet Uysal, Sumit Kewalramani, Benjamin Stripe and Pulak Dutta, Cryst. Eng. Comm. 11, 130 (2009). Journal cover <http://www.rsc.org/delivery/_ArticleLinking/DisplayArticleForFree.cfm?doi=b821539c&JournalCode=CE> How do living organisms shape the inorganic crystals that form shells and bones? This work offers some clues.

James Sauls

"Charge Dynamics of Vortices in Layered Chiral Triplet Superconductors", Matthias Eschrig and J. A. Sauls. We develop the theory vortex dynamics for layered superconductors and apply the theory to the dynamics of vortices in chiral p-wave superconductors. Doubly quantized vortices are predicted to be energetically and dynamically stable at intermediate and high magnetic fields. Online publication: Invited paper, New Journal of Physics (2009) <http://arxiv.org/abs/0904.1819>

Heidi Schellman

"Measurement of the electron charge asymmetry in p anti-p → W + X → eν + X events at $s^{1/2}$ = 1.96-TeV" D0 Collaboration (V.M. Abazov et al.), Phys. Rev. Lett. 101, 211801 (2008). <http://www.slac.stanford.edu /spires/find/hep/www?key=7837160> This is the most precise current measurement of the u/d quark ratio as a function of quark momentum in the proton. It favors a lower u/d ratio at very high quark momenta.

Tim Tait

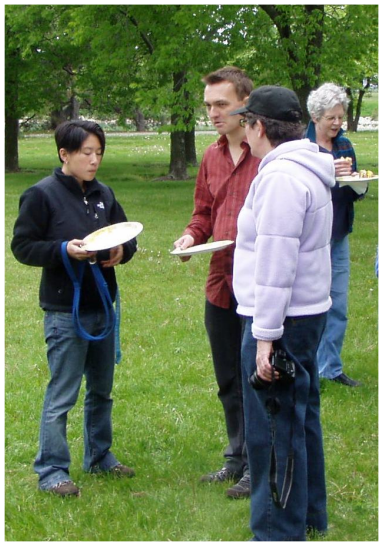
"WIMPonium" W. Shepherd, et. al., Phys. Rev. D 79, 055022 (2009). We explored the possibility that weakly interacting massive dark matter particles could experience long range forces resulting a kind of WIMP 'chemistry'. If this feature is realized in nature, the resulting bound states could be observed at the Fermilab Tevatron or CERN LHC.

Several of our faculty have contributed articles to Northwestern's Science in Society, a web-based science outreach initiative (http://scienceinsociety.northwestern.edu/). **André de Gouvêa**, **Ian Low**, and **Tim Tait** cowrote "Big Ideas, Small Particles", and **Heidi Schellman** wrote "From a Physicist's Mind". The first article is about the physics to be conducted at the LHC (Large Hadron Collider), and the second discusses how physics is connected to everything from MRI scanners to the Internet.

Events (cont.)

Department of Physics and Astronomy Annual Picnic

Memorial Day (May 25, 2009)



Farewell party for three distinguished professors

May 27, 2009

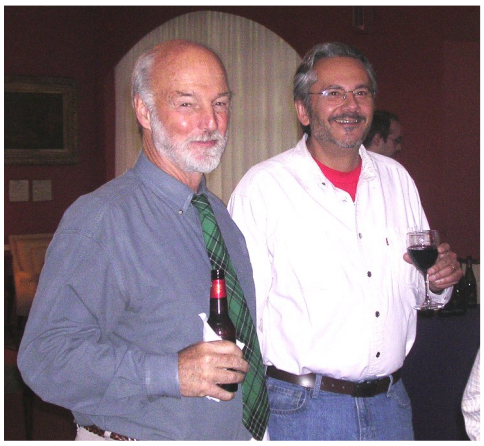
The Department held a party to celebrate the retirement of three professors: Bruno Gobbi, Robert Oakes, and Jerome Rosen. To help celebrate their careers in high energy physics and their contributions to Northwestern, people from around the world mailed reflections and anecdotes to be read aloud at the party, and several people from ound the country traveled here in order to attend.

Bruno Gobbi
NU Professor
1972 - 2009

Robert Oakes
NU Professor
1968 - 2009

Jerome Rosen
NU Professor
1972 - 2009

Heidi Schellman, Master of Ceremonies for the retirement party, presents Bruno Gobbi with a gift.



Jock McLane (Associate Dean of Faculty Affairs, WCAS) and Dan Claes (Associate Professor, University of Nebraska) take part in the festivities.

Faculty, students (past and present), scientists, and other guests listen as Heidi Schellman reads from one of letters from a colleague congratulating Robert, Bruno, and Jerome on their retirement!

Graduate Students (L-R): Ting Xiao, Andrew Mounce, Lee Patrick, Charles Collett

Guests listen as a former student pays tribute to Bruno, Robert, and Jerome.

Dr. Clarence J. Overbeck Endowed Physics Laboratory Teaching Fund

Established through the generous commitment of Dr. Ann Overbeck and Dr. Henry J. Overbeck, the Dr. Clarence J. Overbeck Endowed Physics Laboratory teaching Fund has served as a vital resource for the Department of Physics. The Overbeck endowment enables the purchase of expensive lab equipment, enhancing the quality of instruction Northwestern can provide its undergraduates.

Physics and Astronomy Lecturer Arthur Schmidt, director of the Undergraduate Laboratories, reports that this endowment has made it possible to update our lab with the latest apparatus. Most recently with these funds we have been able to create what we think presents a unique and valuable experience for our students to view and manipulate a beam of electrons. We have purchased the beam tubes and power supplies for this lab. We ran the new lab for the first time this fall. We are forever grateful for the generosity of the Overbeck family and look forward to creating more new and innovative experiments for our undergraduate labs.

In addition through a separate donation from Dr. Ann Overbeck we have had the services of Tom Senior part time in the lecture demo room. Tom is an award winning teacher and active member of PIRA (Physics Instructional Resource Association), a group of physics instructors that are dedicated to the advancement

Tom Senior

of physics instruction. To that end they have organized and maintain a web site of 200 Physics Demonstrations. Among his awards Tom most recently received the AAPT Distinguished Service Citation at the AAPT winter meeting in Baltimore in January. Tom has created a Northwestern Department of Physics and Astronomy Lecture Demonstration Home Page in which he has documented and cataloged all of the Department's lecture demonstrations. The present site is http://wildcat.phys.northwestern.edu/public_html/DemoPageE/MAIN%20DemoPage.html.

Art Schmidt and Tom Senior recently conducted an evening of physics demonstrations in sound and music for the Sigma Xi Science Cafe of Evanston. You can view this on YouTube (http://www.youtube.com/watch?v=OsXSKPFoBl0)

Staff

Welcome New Staff:

Raymond Bailey joined the Academic Office in April as the Undergraduate Assistant. Raymond received his BA from Concordia University. Prior to Northwestern, he worked at Roosevelt University as the Administrative Secretary for the Office of Career Services. He and his wife, Jacquelyn, moved here from Denver, CO August of 2007. They live in the Rogers Park neighborhood of Chicago with their 2 cats, Rocky and Izzy.


Raymond Bailey

Peter Gariepy joined the Business Office in May as the Financial Assistant. Peter received his MS in Taxation and BS in Public Accounting from Fordham University, and has experience in accounting, auditing, and financial analysis. He moved here last August from Queens, NY, but was born and raised just outside of Detroit. He is a Yankees fan and an avid Detroit Lions fan. His favorite thing to do since moving to Chicago, is to ride his bike on the Lakeshore path when time allows. He is eagerly awaiting Dan Brown's new book, "The Lost Symbol".


Peter Gariepy

Alumni

James Chisholm (BA, 1998) has been appointed Assistant Professor at Southern Utah University. Chisholm obtained his PhD from the University of Chicago.

Erhai Zhao (PhD 2006, James Sauls), recently accepted a tenure-track Assistant Professor position in the Department of Physics at George Mason University.

Department Alumni Request:

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. However, it is also a forum for alumni to keep the department abreast of their accomplishments. Therefore, the department welcomes submissions from alumni of newsworthy items for publication in the monthly newsletter. Please send your submissions to physics-astronomy@northwestern.edu or detach the last page of the newsletter and mail it to the department.


A 17th century compound microscope, from an engraving in Robert Hooke's Micrographia. http://www.edinformatics.com/inventions_inventors/microscope.htm

Compiled by Raymond Bailey

Alumni Contribution Form

Name: _____

Degree: _____

Graduation Year: _____

E-mail Address: _____

Phone Number: _____

News:

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