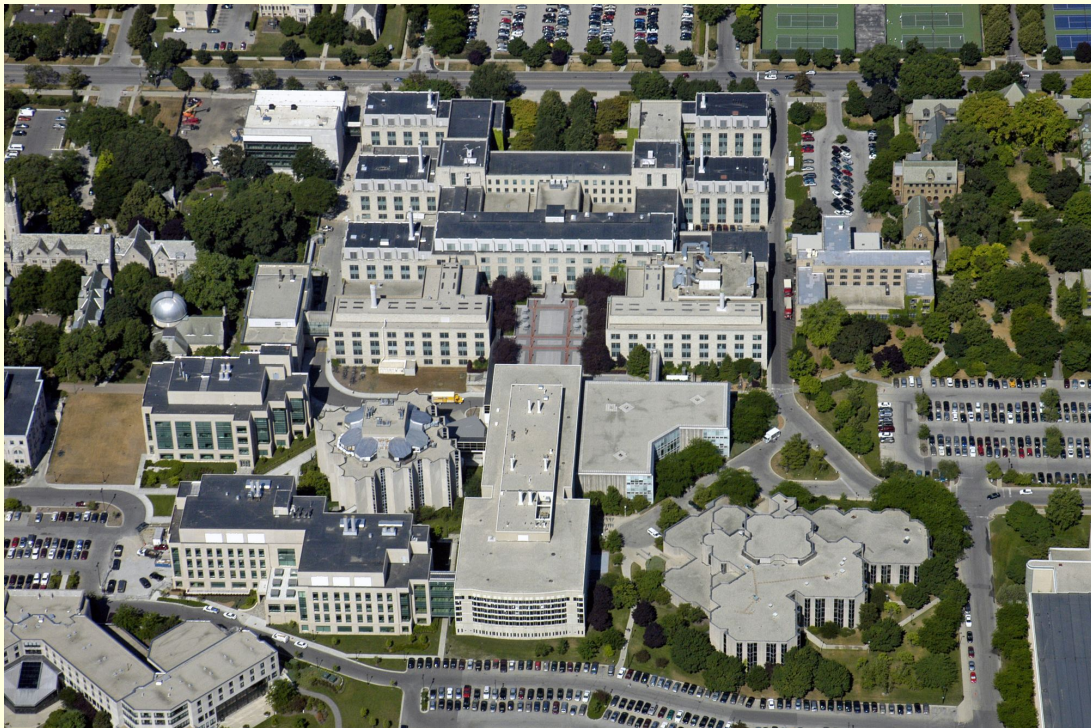


Spring/ Summer 2015

Dimensions

Department of Physics & Astronomy



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Faculty News

Anupam Garg and Anthony Leggett (of the University of Illinois at Urbana-Champaign) continue to challenge experimentalists to find ever more macroscopic manifestations of quantum mechanics. The latest test of the so-called Leggett-Garg inequality shows that Cesium atoms can exist in states with indefinite properties, which while not as drastic as Schrodinger's imagined dead-and-alive cat, are still remarkable.

<http://physics.aps.org/articles/v8/6>

William Halperin testified in Congress on July 8, before the Energy and Mineral Resources Subcommittee of the House Natural Resources Committee to draw attention to this pressing problem that scientific research depends on availability of liquid helium for many different reasons; however, it's short supply and volatile pricing has placed many physics projects at risk. Prof. Halperin is also the USA representative and secretary for the Low Temperature Physics Commission of the International Union of Pure and Applied Physics.

Vicky Kalogera has been awarded one of eight NRT Awards. Along with **Prof. Michael Schmitt** and key participants from EPS, SESP, EECS, and IEMS. Prof. Kalogera will lead interdisciplinary training on data-driven discovery. Over the 5-year duration, the \$3 million award will provide NRT graduate fellowships to over 35 students drawn from multiple existing Ph.D. programs.

Yoram Lithwick and Brian Odom have been granted tenure in the Department of Physics and Astronomy.

Yoram Lithwick and Adilson Motter were featured in Northwestern University's 2014 Research Report highlighting their excellence in research. Lithwick was recognized for measuring the masses and ascertaining the composition of 56 exoplanets. Motter was recognized for the computational modeling of biological and chemical systems using network-based understanding.

Adilson Motter was named a 2015 Simons Fellow in theoretical physics.

Prof. Motter was named a Scialog Fellow and selected by the Research Corporation for Science Advancement and the Gordon and Betty Moore Foundation to participate in the 2-year "Scialog: Molecules Come to Life" initiative.

Prof. Motter gave the opening plenary talk at the 2015 SIAM Conference on Applications of Dynamical Systems, co-located with the SIAM Workshop on Network Science. The talk, which was attended by about 1000 conference attendees, is available online on the SIAM website: <https://www.pathlms.com/siam/courses/1288/sections/1399>

Melville Ulmer has become a two time NIAC Fellow. His most recent NIAC award came in June 2015. He will serve as Principal Investigator for a project "Aperture," short for "A Precise Extremely-large Reflective Telescope Using Re-configurable Elements." The project goal is to develop a viable concept for large deployable space mirrors with post-deployment correction.

http://ciera.northwestern.edu/news/news_2014-2015.php

Melville Ulmer and **Hooman Mohseni** have, along with external collaborator Olivier Guyon of the Subaru Telescope, been awarded a grant from the W.M. Keck Foundation.

<http://www.northwestern.edu/newscenter/stories/2015/07/new-camera-to-helpsearch-for-life-outside-our-solar-system.html>

Mayda Velasco was awarded the Graduate School's Dean's Award for Diversity. The award recognizes Prof. Velasco's strong impact on the Graduate School's aim to become a national leader in diversifying our population of enrolled students, as well as fostering best practices for recruiting, retaining, and encouraging the success of underrepresented minority students.

Prof. Velasco was recently appointed to the The High Energy Physics Advisory Panel (HEPAP). HEPAP has advised the Federal Government on the national program in experimental and theoretical high energy physics research since its inception in 1967. The Panel reports directly to the Associate Director, Office of High Energy Physics, Office of Science (DOE), and the Assistant Director, Mathematical & Physical Sciences Directorate (NSF), under the guidelines established by the Federal Advisory Committee Act (FACA).

Selected Publications

Carl Eric Dahl

Dark Matter Search Results from the PICO-2L C_3F_8 Bubble Chamber by C.E. Dahl and PICO Collaboration. **Phys Rev Lett** **114**, 231302 (2015).

The PICO-2L experiment, a 2-liter C_3F_8 bubble chamber operating 6,800 feet underground at SNOLAB in Sudbury, Ontario, has produced world-leading limits in the hunt for dark matter. Prof. Eric Dahl's group and the PICO collaboration use bubble chambers to look for WIMP's, or Weakly Interacting Massive Particles, one of the leading candidates to make up the dark matter that dominates our universe. WIMPs scattering in the superheated target of the bubble chamber produce single bubbles, which are distinguished from bubbles produced by background radioactivity based on their ultrasonic acoustic signature.

So far, no WIMP signal has been detected, but the PICO-2L experiment leads the field in sensitivity to spin-dependent WIMP-proton interactions.

<http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.114.231302>

Claude-André Faucher-Giguère

Neutral Hydrogen in Galaxy Halos at the Peak of the Cosmic Star Formation History by C.-A. Faucher-Giguère, P. F. Hopkins, D. Keres, A. Muratov, E. Quataert, and N. Murray. **MNRAS**, **449**, 987 (2015).

Cosmological simulations of galaxy formation from the FIRE (Feedback In Realistic Environments) project to make predictions for the circum-galactic gas flows that regulate galaxy growth around the peak of the cosmic star formation history. In this paper, we show that our new models are in excellent agreement with recent measurements of those gas flows around star-forming galaxies at that epoch. FIRE is an ambitious project that our group has been developing for several years, and which has really taken off in the past year, with the submission or publication of no less than 10 new papers since the beginning of 2015, on topics including dark matter, galactic winds, and the chemical enrichment of the Universe.

<http://mnras.oxfordjournals.org/content/449/1/987.full.pdf+html>

Chris Jacobsen

[1] Simultaneous cryo X-ray ptychographic and fluorescence microscopy of green algae by J. Deng, D. Vine, S. Chen, Y.S.G. Nashed, Q. Jin, N.W. Phillips, T. Peterka, R. Ross, S. Vogt and C. Jacobsen. **PNAS** **112**, 2314 (2015).

[2] Continuous motion scan ptychography: characterization for increased speed in coherent x-ray imaging by J. Deng, Y.S.G. Nashed, S. Chen, N.W. Phillips, T. Peterka, R. Ross, S. Vogt, C. Jacobsen, and D. Vine. **Optics Express** **23**, 5348 (2015).

[3] Parallel ptychographic reconstruction by Y.S.G. Nashed, D. Vine, T. Peterka, J. Deng, R. Ross, and C. Jacobsen. **Optics Express** **22**, 32082 (2014).

Ptychography is a coherent x-ray microscopy method that uses multiple overlapping illumination spots to reconstruct an image from far-field diffraction patterns. It is able to work at a resolution limited not by optics, but by the scattering strength of the sample, and it delivers a phase image which can have a contrast hundreds or thousands of times higher than absorption contrast for lighter atoms using high energy X-rays. A team from Argonne and Northwestern University has worked together to achieve three separate advances in x-ray ptychography. Northwestern PhD student Junjing Deng showed the use of two imaging methods at once to obtain complementary information on cells that were quickly frozen from the living state: ultrastructural information at sub-30 nanometer resolution by ptychography, and x-ray fluorescence measurements of trace element distributions at sub-100 nanometer resolution [1]. This lets one put elemental distributions into their proper biological context. In another advance, Deng and others have also shown that one can speed up data collection by the use of continuous scanning [2], rather than having to repeat a stop-measure-move sequence for each illumination spot. The speedup achieved is about threefold at present, but with the planned high brightness upgrade of the Advanced Photon Source (APS) the speedup can be a factor of 100 or more. Finally, Dr. Youssef Nashed of the Mathematics and Computer Science Division at Argonne and others have developed a ptychography computer code that runs at the Argonne Leadership Computing Facility (ALCF) to speed up image reconstruction by more than a factor of 10,000 relative to previously-used code [3], by employing graphical processing units (GPUs)

on individual compute nodes and distributing the task over more than 100 nodes in the cluster. This allows experimenters like Deng to see their images immediately, rather than waiting until days later. Together, these advances point the way towards high speed imaging without lens limits to the resolution achieved, and this capability is central to the planned Multi-Bend Achromat lattice upgrade of the APS.

<https://www1.aps.anl.gov/APS-Science-Highlight/2015/Ptychography-for-Beautiful-Images>

Adilson Motter

Comparative analysis of existing models for power-grid synchronization by T. Nishikawa and A.E. Motter. **New J. Phys.** **17**, 015012 (2015).

This study offers a comprehensive comparative analysis of the leading models recently used to study synchronization dynamics in power-grid networks. The proposed framework allows one to view power grids as complex networks of coupled second-order phase oscillators with both forcing and damping terms. It is demonstrated, in particular, that if the network structure is not homogeneous, generators with identical parameters need to be modeled as non-identical oscillators in general.

<http://dx.doi.org/10.1088/1367-2630/17/1/015012>

Brian Odom

Doppler amplification of motion of a trapped three-level ion by X. Chen, Y.-W. Lin, and B.C. Odom. **New Journal of Physics** **17**, 043037 (2015).

Illuminating atoms with laser light detuned to the low-frequency side of resonance slows down the atoms and cools them, in a process called Doppler cooling. Illuminating trapped atoms with light detuned to the high-frequency side of resonance amplifies their initial speed but, counter-intuitively, does significantly increase their temperature. In this article, we theoretically explore this process of Doppler amplification for atoms in which three quantum levels play a role, and we study its use for non-destructive state readout of trapped molecular ions.

<http://iopscience.iop.org/1367-2630/17/4/043037/>

James Sauls

Anisotropy and strong-coupling effects on the collective mode spectrum of chiral superconductors: application to Sr_2RuO_4 by J.A. Sauls, Hao Wu and S-B Chung.

Frontiers in Physics **3:36** (2015).

Recent theories of Sr_2RuO_4 based on the interplay of strong interactions, spin-orbit coupling and multi-band anisotropy predict chiral or helical ground states with strong anisotropy of the pairing states, with deep minima in the excitation gap, as well as strong phase anisotropy for the chiral ground state. We develop time-dependent mean field theory to calculate the Bosonic spectrum for the class of 2D chiral superconductors spanning 3He-A to chiral superconductors with strong anisotropy. Chiral superconductors support a pair of massive Bosonic excitations of the time-reversed pairs labelled by their parity under charge conjugation. These modes are degenerate for 2D $^3\text{He-A}$. Crystal field anisotropy lifts the degeneracy. Strong anisotropy also leads to low-lying Fermions, and thus to channels for the decay of the Bosonic modes. Selection rules and phase space considerations lead to large asymmetries in the lifetimes and hybridization of the Bosonic modes with the continuum of un-bound Fermion pairs. We also highlight results for the excitation of the Bosonic modes by microwave radiation that provide clear signatures of the Bosonic modes of an anisotropic chiral ground state.

<http://journal.frontiersin.org/article/10.3389/fphy.2015.00036/abstract>

Farhad Yusef-Zadeh and Doug Roberts

Radio Continuum Observations of the Galactic Center: Photoevaporative Proplyd-like Objects near Sgr A* by F. Yusef-Zadeh, D. A. Roberts, M. Wardle, W. Cotton, R. Schodel & M.J. Royster. **The Astrophysical Journal Letters**, **Volume 801**, **Issue 2**, **article id. L26**, **7 pp.** (2015).

This work used the integration of visualization and astronomical publishing with the creation of the first Video Abstract of a paper published by the American Astronomical Society. The video abstract is published with the on-line version of the paper at the publisher's website.

It was created entirely using WorldWide Telescope (<http://worldwidetelescope.org>) and represents initial steps of bringing visual representations of data and science results to people in interactive and video formats.

The video abstract is available on YouTube:
<https://www.youtube.com/watch?v=zYk1-lsVFdc>. If you have a copy of WorldWide Telescope you download, run and edit the Tour used to create the video here:
<http://1drv.ms/1OUuHm9>

"Sky and Telescope featured this work, noting that stars could be forming near the supermassive black hole at the center of the Milky Way, which was previously thought to be too hostile for such activity."

<http://www.skyandtelescope.com/astronomy-news/new-stars-shadow-black-hole-0303201523/>

Research Staff



Sourav Chatterjee a CIERA Postdoctoral Fellow and Jonathan C. Tan from University of Florida have published a study in the *Astrophysical Journal Letters* that show that the properties of the innermost planets of the short-period, compact multi-planet systems, christened "Vulcans" by the authors, are well matched by the predictions of a radically new formation mechanism for these planetary systems, proposed earlier by the same authors in the *Astrophysical Journal*. A major challenge for traditional planet formation theories is to explain the delivery of the required high mass of solid, planet forming material so close to the star from which these compact systems can form. The "Inside-Out Planet Formation" theory proposed by Chatterjee and Tan explains how delivery of material can happen quickly from much further out. In addition, it explains how, upon delivery, cm- to m-size pebbles could quickly grow to planets, the most uncertain step of planet formation.

<http://adsabs.harvard.edu/abs/2015ApJ...798L..32C>

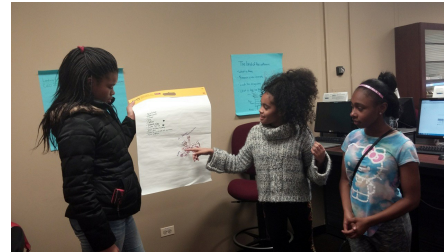


Lei Liu joined the research group of Nathaniel Stern as a new post-doc. Lei is an expert in chemical growth of two-dimensional crystals and their heterostructures (which is closely related to the topic of our recent Heilborn lectures by Professor Kostya Novoselov).



network dynamics.

Ferenc Molnar joined Prof. Motter's group as a post-doctoral fellow in January 2015. He was previously a graduate student at the Rensselaer Polytechnic Institute in Troy, NY. Dr. Molnar is conducting research in



Laura Trouille and Laura Fissel, CIERA

Postdoctoral Fellows led a new 'Mission to Space' workshop during

Expanding your Horizons on March 28, 2015.

Expanding your Horizons is a day-long STEM event for 6th-8th grade girls. Most of the over 200 participants were Chicago Public School students.

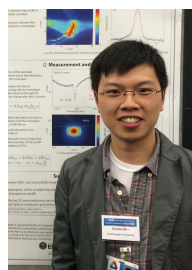
Throughout the day the girls participated in hands-on STEM activities with women in STEM mentors. In the CIERA workshop, the girls designed their own Mission to Europa, Io, or Mars using WorldWide Telescope, including designing their own rover to best address their science questions. Northwestern undergraduate student Casey Norlin collaborated with Laura Trouille on creating the workshop materials. They had a blast!



Laura Trouille recently became the Director of Citizen Science at the Adler Planetarium. Dr. Trouille will lead a team of software developers, educators, and researchers in

supporting the Zooniverse and Adler's efforts to engage the public in doing science. The Adler is the North American headquarters for Zooniverse (zooniverse.org), the world's largest and most successful collection of citizen science projects. In these projects, the public (online volunteers) use their human ability to recognize patterns and classify objects to help scientists analyze our increasingly large data sets. More than a hundred peer-reviewed papers have been published using citizen science data derived from Zooniverse projects; recent highlights include a census of animal populations in the Serengeti national park and the discovery of a distant galaxy magnified by an intervening gravitational lens.

Yet the projects have significant educational as well as scientific appeal; research into the behavior of Zooniverse volunteers shows that participation in online citizen science acts as a powerful stimulus to scientific curiosity. With 1.3 million volunteers, the Zooniverse has established itself as the leading platform and community for engaging the public in doing science.

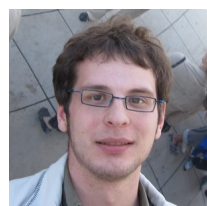


Guohua Wei from the group of Nathaniel Stern was awarded the CNM Best Student Poster Prize at the 2015 APS/CNM Users Meeting for his poster titled "Integrated Photonics with Single Layer MoS₂".

Graduate Achievements



Peter Ashton and Carl Rodriguez, Physics and Astronomy graduate students in the CIERA, have each won a \$10,000 Graduate Fellowship from the Illinois Space Grant Consortium. Professor Melville Ulmer has been the principal investigator on the ISGC for almost 30 years, since its inception.



Joshua Fixelle, a first-year graduate student, has been awarded an NSF Graduate Research Fellowship. Fixelle works with Professor Fred Rasio.

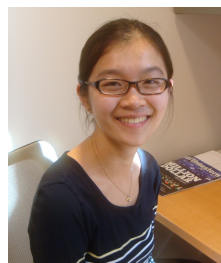


Megan Morscher won the Martin and Beate Block Award for her presentation at the Aspen Center for Physics winter conference on Black Holes in Dense Star Clusters. The Block, given to one promising young physicist at each winter conference is in honor of P & A Emeritus Professor Martin Block, founder of the winter conference series. Megan received training in science communication through Northwestern University's Ready, Set, Go, a program started by CIERA and adopted by The Graduate School as a flagship graduate student communication training program.

Undergraduate Achievements



Rui Chen has received the Outstanding Junior award. He is doing research work with Professor Dave Meyer on examining characteristics of nearby, cold interstellar clouds. Also, this summer he will work with NOAA scientists at the National Tsunami Warning Center in Hawaii to study dynamics of Tsunami waves.



Xiaowen Chen has received the Prize for Distinguished Honors Thesis for her senior thesis entitled "Fractal Geometry of Undriven Dissipative Systems". The award is given by Northwestern's Integrated Science Program (ISP). Xiaowen is an undergraduate majoring in Physics, Mathematics, and ISP, and has performed her research on transient chaos in Prof. Adilson E. Motter's group. She is graduating this spring and will join Princeton University in the fall to pursue her graduate studies in physics.

Jessie Duncan, Anya Kogan, Ben Sandeen, Daniel Kinch, Remy Millman have been awarded a Weinberg College Summer Research Grant in the amount of \$3000.00. This award is made possible by the generous support of the Slosburg Undergraduate Research Fund and Weinberg College of Arts and Sciences alumni.



Daniela Deleon, Jessie Duncan, C.J. Hansen, Remy Millman, Amanda Newmark, Paul Williams, Seth Krantzler, Leah Perri, and David Rice were all awarded funds for summer research, under Prof. Melville Ulmer's NASA Illinois Space Grant Consortium Research Experience for Undergraduates (REU) program. In addition, another nine students from across the country have converged on Northwestern as part of CIERA's new NSF-funded REU program (PI: Prof. Vicky Kalogera), managed by CIERA Postdoctoral Fellows Laura Trouille and Aaron Geller.

Staff News

Agnes Engstrom passed the CRA exam to become a Certified Research Administrator. The CRA is a designation granted to individuals who demonstrate the knowledge necessary to serve as an administrator of professional and sponsored research projects. Agnes is the Associate Research Administrator in Physics and Astronomy's Business Office.



Gretchen Oehlschlager joined CIERA in May, 2015 from Northwestern's Office of Undergraduate Research where she handled communications, events, and finances. She has been with the university almost seven years, initially working with faculty appointment records in the Office of the Provost and supporting its student-focused units. Gretchen enjoys playing with her dogs, watching TV, cooking, and doing nearly any "culturally potent" activity. She loves carpooling to campus from Skokie with her husband, also an NU staffer.

Alumni Focus



Timothy Andeen will be an assistant professor in Physics at UT Austin this Fall. For the last five years he has been working at Nevis Labs at Columbia University. He will continue doing research with the ATLAS experiment at CERN, where his group will focus on searching for exotic new particles and building instrumentation for detector upgrades. Timothy graduated in 2008 from NU with a Ph.D. in Physics and worked in the Schellman Group.

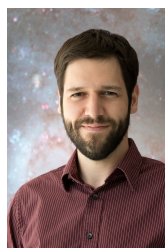
Spring/ Summer 2015



Shyam Bharadwaj will begin to work on his Ph.D. in electric and computer engineering at Cornell University this Fall. He will be working on optimizing semiconductors (the materials they are made of, their size, and their power consumption). Mainly, he will focus on one or two of these areas. He says "the scope is broad - semiconductors are fundamental in making transistors and other devices, so IC's and other larger scale devices will benefit from smaller/more power efficient semiconductors. One of the most interesting applications to me is UV light filtration - an LED emitting at a certain wavelength will kill bacteria effectively, making for a potentially cost-effective, compact water filtration system." Shyam graduated in 2015 with a BS in Electrical Engineering from the McCormick School at NU, and he worked with Prof. Claude André Faucher-Giguère.



Matthew Dietrich, currently a Research Assistant Professor in the Odom group, will be starting in the Fall, a tenure-track job as an Assistant Physicist at Argonne National Laboratory. At Argonne, he will be leading the effort searching for a radium electric dipole moment. He says, "I will focus on furthering our success in measuring the electric dipole moment of radium-225, a result recently published in Physical Review Letters. The electric dipole moment of radium is especially sensitive to tiny violations of certain fundamental symmetries today thought to be essentially perfect in the Standard Model of particle physics. The observation of a non-zero electric dipole moment would herald the discovery of hitherto unknown physics, and help explain mysteries such as the matter-anti-matter asymmetry of the universe. Although no such signal has yet been found, we plan to enormously improve the sensitivity of this table-top experiment in the next few years."



John Hewitt will be an Assistant Professor of Physics at the University of North Florida in August. He received a B.A. in May 2004 (double-major in Math and Physics with Honors), and Ph.D. in July 2009 at Northwestern. He was a NASA postdoctoral fellow in the x-ray lab at Goddard, then moved to his current position as a CRESST Research Associate in the Astroparticle Physics Lab to work on

NASA's Fermi Gamma-ray Space Telescope. His research focus has been on particle acceleration and transport in our Galaxy, focusing on supernova remnants, the Galactic center and the origin of cosmic rays. John currently the Galactic coordinator in the Fermi LAT collaboration.



Kyle Kremer has been awarded an NSF Graduate Research Fellowship. He worked with Professor Vicky Kalogera, and graduated from Northwestern in 2012. He was the recipient of a Churchill Scholarship to study astrophysics at the University of Cambridge.



Barbara Kegerreis Lunde earned her BA and MS in physics from Northwestern University in 1957 and 1959. She was a Research Engineer in the Draper Laboratory at MIT, where she helped with the guidance system of the Minuteman missile and the development of a digital accelerometer, resulting in two patents. At the Goddard Space Flight Center of NASA, she was the Project Manager for the Reliable Earth Sensor. She moved to Ames, IA to help start a commercial FM radio station and work on her Ph.D. in physics at Iowa State University, which she received in 1970. She was VP and Chief Engineer of the Ames station and, later, a new one in Ankeny, IA for 12 years. After earning her Ph.D., she taught in the physics, engineering departments at Iowa State University. She developed and taught the first Spacecraft Systems course for Aerospace Engineering, and the first Remote Sensing course for both the Aerospace Engineering and the Civil Engineering departments. She obtained a NASA contract for the development of a metal purification experiment to be done on the Space Shuttle. She became Iowa's first female electrical Professional Engineer. After leaving Iowa State University, she worked for Brooks Borg and Skiles in Des Moines, IA, designing a solar energy system to feed steam into the Iowa Capitol Complex power plant, other solar work, and the electrical design of buildings. Later, she sold energy management systems for CenturyLink, selling more than anyone else. She also designed fiber optic communication systems for CenturyLink. She moved to Washington, DC, continuing the electrical design of

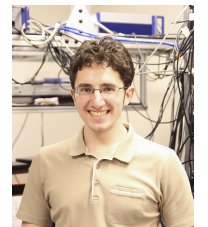
buildings and communication system design. In 2003, she joined the Office of Commercial Space Transportation within the FAA as Training Specialist. The office protects the public from harm due to commercial rocket launches. She retired from the FAA in 2013 and moved to Minneapolis to babysit a new grandson. She also tutors there. The picture is of Barbara receiving the Minnesota Federation of Engineering, Science and Technology Societies' highest honor, the Richard S Alberg Distinguished Science and Technology Professional Award for 2015 for lifetime achievements in and service to the practice of science and technology.



Alex McKale has worked in the high tech field at Apple and Hewlett Packard. Now, he has returned to the academic world, and for the past four years, he has been teaching AP and Honors Physics at the Stanford Online High School. In addition to the academics, Alex is in a science speakers club, a theoretical physics book club, a physics competition club and a robotics club. He graduated in 1987 from NU with a MS and Ph.D. in Physics and worked with William Halperin.



Mark Meisel is a Physics Professor at the University of Florida. Next year will mark his 30th year at UFL. He started working for William Halperin as an undergraduate in the Fall 1977, receiving his BA in Physics in 1980, then a MS in Physics 1981, and finally his Ph.D. in Physics in 1983 at NU.



Stephen Okoniewski has been awarded an NSF Graduate Research Fellowship. He is currently a Ph.D. candidate in physics at the University of Colorado, Boulder. He graduated from Northwestern in 2013, and worked with Professor John Ketterson, and published a first author paper during that time.

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".



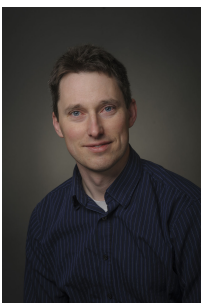
Johannes Pollanen is an endowed assistant professorship of Cowen Chair in Experimental Physics at Michigan State University. He is busy setting up a new low temperature laboratory.

His experimental research group will focus on exploring the fundamental physics and potential quantum information applications of low-dimensional and topological electron systems. They will combine expertise in two-dimensional electron systems and low temperature physics to create and study hybrid quantum systems composed of free electrons floating on the surface of liquid helium and coupling these electrons to nanoscale structures and topological states of matter. Johannes graduated in 2012 with a Ph.D. in Physics, where having discovered new chiral phases of superfluid ^3He working in the Halperin group's ultra-low temperature laboratory.

Benjamin Stripe graduated in 2012 from NU with a Ph.D. in Physics and worked in the Dutta group. He has joined Sigray, an x-ray technologies company in Concord, CA, as Staff Scientist.



Ahmet Uysal has recently joined Heavy Elements and Separations Science group at Argonne National Laboratory as a Staff Scientist. His research will focus on molecular-scale understanding of interfacial structures and processes related to heavy element separations. Ahmet graduated in 2012 with a Ph.D. in Physics under supervision of Pulak Dutta.



Anton Vorontsov will begin this Fall as a Associate Professor in Physics department at Montana State University. He is head of the condensed matter theory group, and conducts research in superfluid He-3 and novel superconductors. Anton explores superfluid phases in confined geometry,

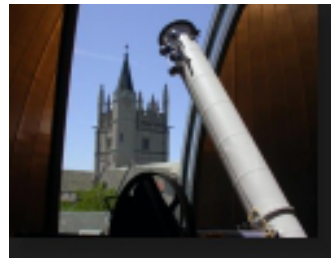
and influence of magnetic fields and competing interactions on superconducting states. His group investigates experimental properties of non-uniform condensates, and interplay of superconductivity with magnetism. Anton graduated in 2004 with a Ph.D. in Physics, and worked in the Saul's group. Also, he was named Cottrell Scholar thru 2016.

Spring/ Summer 2015



Guanyu Zhu will start research as a postdoc at the Joint Quantum Institute (JQI)/University of Maryland and NIST. His research will focus on many-body theory and topological aspects of strongly-interacting photons and other topics related to quantum information and quantum computation. In addition, he will be collaborating with experimentalists at Princeton, U Chicago and JQI to realize topologically-protected states in superconducting circuits for future application in fault-tolerant quantum computation. Guanyu graduated in 2015 with a Ph.D. in Physics and worked in the Koch group.

Dearborn Observatory



The Dearborn Observatory is open for public observing with the historic 18.5" refracting telescope every Friday night.

Visiting schedule:

Spring/Summer Hours (April-September)

9-10 pm: One hour session by reservation only. Your group will be able to use the telescope for the full hour.

10-11 pm: Walk-ins are welcome, but space in the dome is limited.

Fall/Winter Hours (October-March)

8-9 pm: One hour session by reservation only.

9-10 pm: Walk-ins are welcome.

There is no charge for these Friday night tours; however, we do require a refundable deposit for groups of 10 or more. Additionally, the Observatory is available for private viewing events on other evenings. To place a reservation, or for more information, contact Monica Brown at 847-491-7650 or monica.brown@northwestern.edu

2014-2015 PhD Graduates



Ben Farr (Vicky Kalogera).
Thesis title: Extracting Astrophysical Information from the Gravitational Waves of Compact Binary Mergers and Their Electromagnetic Counterparts.



Rachel Mak (Chris Jacobsen).
Thesis title: Reducing complexity: A regularized non-negative matrix approximation (NNMA) approach to x-ray spectromicroscopy analysis.



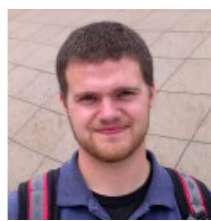
Laszlo Frazer (John Ketterson).
Thesis title: Excitons in Cuprous Oxide: Photoionization and Other Multiphoton Processes.



Meagan Mosher (Frederic Rasio).
Thesis title: Modeling the Dynamical Evolution of Stellar-Mass Black Holes in Globular Clusters.



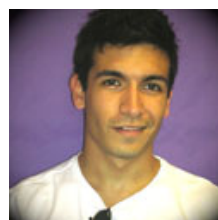
Jen Hobbs (Mitra Hartmann).
Thesis title: Patterns of contact across the rat vibrissal array: first steps toward quantifying the vibrissotactile natural scene.



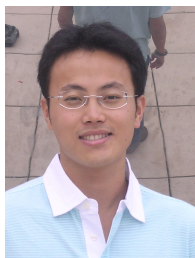
Nate Odell (Mayda Velasco).
Thesis title: Search for Flavor-Changing Neutral Higgs Decays from Top Quarks with Multilepton Final States.



Andrew Kobach (André de Gouvêa).
Thesis title: The Inverse Puzzle in Particle Physics.



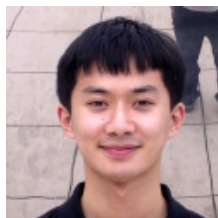
Brian Pollack (Mayda Velasco).
Thesis title: The Search for the Higgs Boson and New Resonances Decaying to a Z and a Photon.



Kanber Lam (Arthur Freeman).
Thesis title: Methodologies in search for p-type transparent conductors.



Chien-Yu Lien (Brian Odom).
Thesis title: Broadband Optical Cooling of Molecular Rotors.



Jia Li (William Halperin).
Thesis title: Transverse Pulsed NMR of Superfluid ^3He in Aerogel: Engineering Superfluid States with Disorder.



Guanyu Zhu (Jens Koch).
Thesis title: Quantum simulation with circuit-QED lattices: from elementary building blocks to many-body theory.

2015 Senior Class Graduates Northwestern's Society of Physics Students (SPS)

We congratulate all of our graduates and wish them the best:

James Bueghly will pursue a PhD in Physics at NU.

Xiaowen Chen will pursue a PhD in Physics at Princeton.

Siyuan Cai

Jason Du will pursue a MS in Statistics at the University of Washington.

Emily Ellinger

Fillan Grady

Matthew Hroma

Erik Johnson

Tyler Karian

Kathryn Lalla will be returning to Austin, TX to pursue certification in teaching to teach Physics at the high school level.

Abraham Lam

Daeyoung Lee

Insu Paek

Robert Parrillo

Justin Scaife

Alexander Schlehuber

Emily Wilson

Congratulations on the new Officers for the coming year. President Lauren Barmore, Treasurer Kelly Powderly, Secretary Dara Rubin, PR Joon Park, Programming Mihir Swaroop, Publicity Vivian Chen, and Historian Rachel Inderhees. We are looking forward to an exciting and vibrant group in the next quarter.



Back row: Arthur Schmidt, Alek Jansen, Joon Park, Mihir Swaroop, CJ Hansen, Insu Paek

Front row: Vivian Chen, Lauren Barmore, Dara Rubin, Rachel Inderhees, Kelly Powderly, Slobodan Mentovi .

The annual Sigma Pi Sigma Induction Ceremony took place Thursday Jun 4, 2015 at 2 pm. The following Physics students were added to the roster of over 200 honorees that have been inducted since the chapter became active in June of 1986.

Daniil Abramov
Xiaowen Chen
Austin Dickey
Golam Mohammed Kashef
Robin Zhiyuan Luo

The half hour ceremony included a signing in of inductees into our member log. It was followed by the traditional Sigma Pi Sigma cake and refreshments. Arthur Schmidt has been the advisor to the group since it was reactivated. The Northwestern Chapter of Sigma Pi Sigma was first formed in 1970 at which time eight original members were inducted.



Department Events

Heilborn Lectures 2015

Walter and Christine Heilborn Lectures 2014-15
Department of Physics and Astronomy
Northwestern University



Prof. Kostya Novoselov
Professor, University of Manchester
Nobel Prize in Physics, 2010

Wednesday, May 13 at 4:00 pm:
**“Twist-controlled electronic properties of
van der Waals Heterostructures”**
Tech LR3

Friday, May 15 at 4:00 pm:
“Materials in the Flatland”
Tech LR2
Streaming for overflow in LR5

Coffee at 3:30 pm
Technological Institute, 2145 Sheridan Road, Evanston, IL

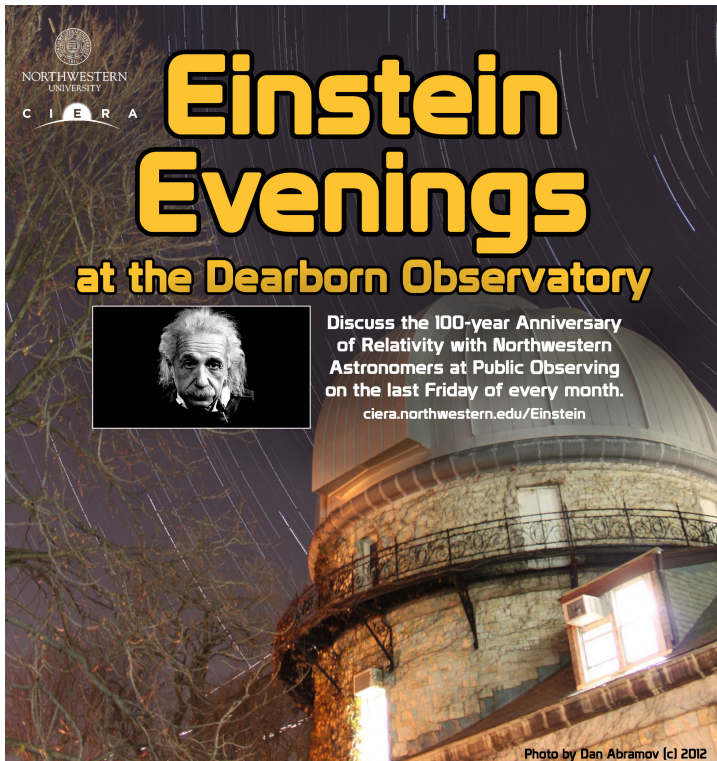
For more information, Contact Pamela Villalovoz at (847) 491-3644 or pmv@northwestern.edu

Since 2001 the Department of Physics & Astronomy has invited distinguished scientists to deliver lectures supported by the Walter and Christine Heilborn fund. In 2015 we welcomed the Nobel Laureate Kostya Novoselov, Langworthy Professor of Physics at the University of Manchester, UK. Prof. Novoselov is a condensed matter physicist, whose Nobel citation is “for groundbreaking experiments regarding the two-dimensional material graphene.” His 2005 and 2004 papers in Nature and Science are the most cited papers on graphene, the latter being one of the most cited papers in physics.

Prof. Novoselov delivered lectures on May 13 and May 15, 2015, entitled “Twist-controlled electronic properties of van der Waals Heterostructures” and “Materials in the Flatland.” The talks drew large audiences from Physics & Astronomy and various departments of the University, particularly Materials Science. Following the May 15 members of the faculty hosted a dinner in honor of Prof. Novoselov. Recordings of the talks may be viewed at the Heilborn website:

heilbornlectures.northwestern.edu/videos/

Einstein Evenings Program



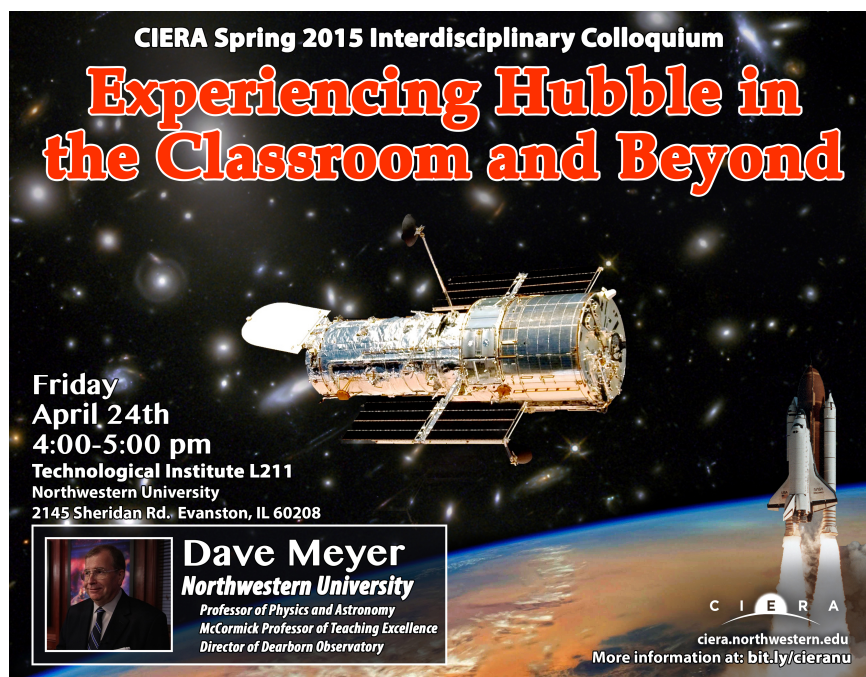
CIERA has launched a Public Outreach activity for the duration of 2015. These events are inspired by the 100 year anniversary of Einstein's theory of relativity. Guests will have the opportunity to meet CIERA postdoctoral associates, graduate and undergraduate students on the last Friday of every month at Dearborn Observatory on the Northwestern campus. They will discuss their research, share some exciting visualizations, and answer questions.

Neil deGrasse Tyson Ignites CIERA Annual Public

Students, faculty, staff, and a range of Northwestern University community members gathered May 14, 2015 for an exceptional evening with celebrated astrophysicist, Neil deGrasse Tyson. Dr. Tyson presented This Just In: Latest Discoveries in the Universe, a lively talk which blended his personal and professional spheres of astronomy, socio-politics, and popular culture. Students, encouraged by Dr. Tyson's open approach and invitation to dialog, lined the aisles to ask questions after the talk.



Professor Meyer Highlights Hubble's Contributions to Astronomy Education in CIERA Spring Interdisciplinary Colloquium



CIERA Spring 2015 Interdisciplinary Colloquium
Experiencing Hubble in the Classroom and Beyond

Friday
April 24th
4:00-5:00 pm
Technological Institute L211
Northwestern University
2145 Sheridan Rd., Evanston, IL 60208

Dave Meyer
Northwestern University
Professor of Physics and Astronomy
McCormick Professor of Teaching Excellence
Director of Dearborn Observatory

CIERA
ciera.northwestern.edu
More information at: bit.ly/cieranu

Professor Dave Meyer has found Hubble Space Telescope data to be productive in two different ways: not only does he use Hubble data for his research, to examine the Interstellar Medium of our Galaxy, but he has found Hubble images to be unparalleled in their ability to excite students and the public about astronomy, and to bring astronomy discoveries to everyone. He presented both the astronomical and educational contributions of the Hubble Space Telescope in the 2015 CIERA Spring Interdisciplinary Colloquium, entitled "Experiencing the Hubble Space Telescope in the Classroom and Beyond"; the talk was also given as a Colloquium in the Department of Physics & Astronomy.

From Chemistry Labs to Star Forming Regions in the Galaxy: Astrochemistry at the CIERA Winter Interdisciplinary Colloquium

Professor Ben McCall (University of Illinois at Urbana-Champaign) visited CIERA on Tuesday, February 10th, to deliver the 2015 CIERA Winter Interdisciplinary Colloquium. Prof. McCall is an expert in connecting chemistry and astronomy. His talk was entitled: "Astrochemistry: From H_3^+ to C_{60} "; the talk focused on how laboratory studies of complex molecules help astronomers investigate such diverse regions as diffuse interstellar clouds, dense molecular clouds, and outflows from stars.



Dimensions was compiled by Monica Brown

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 Monica Brown monica.brown@northwestern.edu.

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Northwestern University
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Tech F219
Evanston, IL 60208-3112



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