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# A Letter from the Department Chair

Dear Friends of the Department,

There are several theories bantered about which suggest that since the 20th century was highlighted by advances in physics that the 21st century is poised to be the century of biology.

Part of this argument suggests that the advances in technology, which are inherently physics and chemistry advances, are allowing for greater tools which aid life science research. With research involving high-throughput genomics sequencing, this is just such the case.

However, there is a fundamental flaw in this overall theory with which I have an issue. The theory gives the subtle impression that major advances and breakthroughs in physics are a thing of the past. Therein lies my issue.

Physics today is not only relevant, but becoming more relevant and continuing to advance science every day. Consider some of the revolutions currently driven by physicists:

🔍 CERN's LHC is producing astounding new results, and the new data indicate that the discovery of the last missing piece in the Standard Model, the Higgs Boson, is tantalizingly close. At MSU, our particle physics group is part of this international effort and among the program's leaders. The story on page 7 highlights Wade Fisher's efforts to combine all of the current datasets on the Higgs Boson.

🔍 New materials with ever-more amazing properties are being developed and discovered. Among these materials is graphene, a hexagonal lattice of carbon atoms in two-dimensional layers. Graphene promises new applications in microelectronics, of which we have yet to scratch the surface. Our newly formed complex materials group is at the forefront of the materials revolution.



Wolfgang Bauer

🔍 New isotopes, which push the drip lines further back and have deep astrophysical implications, are being discovered at an accelerated rate. Our nuclear physics group at the NSCL is among the worldwide leaders in this field, and the new FRIB facility will allow us to jump even further ahead.

Our graduate program in nuclear physics was again rated number 1 in the US News & World rankings, and our strong research program in nuclear physics is a big reason for this ranking.

🔍 Biophysics is beginning to provide microscopic explanations for biological processes. The article on page 3 discusses the work from Lisa Lapidus' research group seeks to understand protein folding and its connection to Parkinson's Disease.

🔍 Astronomy and astrophysics continues to make deep discoveries about our universe. Our astronomy group is putting our SOAR telescope to use in participating in this age of discovery, and the story on page 10 shows how ancient pulsars let us learn about the formation of our own galaxy.

While I could cite many more examples, perhaps the most exciting story I can share is that the number of our students continues to increase. A decade ago, there were around 100 physics and astronomy majors at MSU. This year, we have approximately 300 students in our program!

The demand for our degrees in physics and astronomy is strong and, equally important, our graduates are moving into successful careers. While many of our recent graduates have found jobs in industry, we have had more than 60% of our recent graduates enroll in graduate school at other prestigious universities around the country. In my mind, our department is only as successful as its graduates as they are the best reflection of our work and the quality of our program. As I speak with alumni and review the annual destination data of recent graduates, it is clear that our graduates are very successful in their careers in industry, business, government, and academia.

Our success continues to grow, and for that I express sincere appreciation for everything our alumni do to support our programs. Regardless of how many days or years it has been since you were in East Lansing, you will forever be a Spartan and a major factor in our success. The future of physics is exciting and we appreciate your continued support of our programs as we continue to shape future generations. 🔍

With best wishes,

A handwritten signature in blue ink that reads "Wolfgang Bauer". The signature is fluid and cursive.

Wolfgang Bauer  
Chair

Department of Physics and Astronomy

# Protein Folding Research Fights Parkinson's Disease

Curcumin, a compound found in the spice turmeric, is proving effective at preventing clumping of a protein involved in Parkinson's disease, according to research led by Basir Ahmad, a postdoctoral researcher with associate professor Lisa Lapidus.

Earlier this year, the team's research showed that slow-wriggling alpha-synuclein proteins are the cause of clumping, or aggregation, which is the first step of diseases such as Parkinson's. A study published in the *Journal of Biological Chemistry* shows that curcumin can help prevent clumping.

"Our research shows that curcumin can rescue proteins from aggregation, the first steps of many debilitating diseases," said Lapidus who co-authored the paper with Ahmad. "More specifically, curcumin binds strongly to alpha-synuclein and prevents aggregation at body temperatures."

Lapidus' lab uses lasers to study protein folding. Proteins are chains of amino acids that do most of the work in cells. Scientists understand protein structure, but they don't know how they are built

- a process known as folding. Lapidus' team is examining the process by correlating the speed at which protein folds with its tendency to clump or bind with other proteins.

When curcumin attaches to alpha-synuclein it not only stops clumping, but it also raises the protein's folding or reconfiguration rate. By bumping up the speed, curcumin moves the protein out of a dangerous speed zone allowing it to avoid clumping with other proteins.

The scientists are looking to find a compound that can fix a protein when it first begins to misfold. This could allow researchers to identify drugs that can treat certain diseases.

"Curcumin's usefulness as an actual drug may be pretty limited since it doesn't go into the brain easily where this misfolding is taking place," she said. "But this kind of study showcases the technique of measuring reconfiguration and opens the door for developing drug treatments." 🌱



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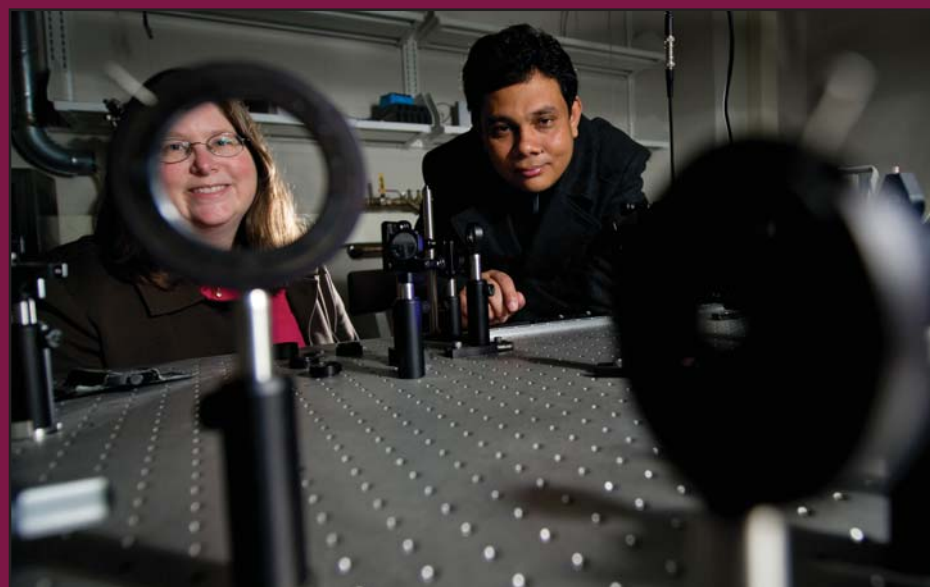
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Contributing writers: Wolfgang Bauer, Alex Parsons, Mike Steger and many other faculty and alumni provided content for the publication.

[www.pa.msu.edu](http://www.pa.msu.edu)



Lisa Lapidus, associate professor of physics and astronomy, and Basir Ahmad, postdoctoral researcher, demonstrated that curcumin is effective at attacking Parkinson's disease.



## Students Experience the History of Physics in Study Abroad Course

In 1905, physics rebooted. The trigger: five seminal papers that started both relativity and quantum mechanics. The person: a civil servant moonlighting in what was to become theoretical physics. The location: the quaint town of Bern, Switzerland.

Last summer, a group of MSU students went on a Study Abroad course exploring the roots of this physics revolution on location in Europe. The course was led by Professor Catherine Westfall and Professor Gerd Kortemeyer, and it was the second time they organized this class.

Over five weeks, the class visited Munich, Bern, Zurich, Berlin, and Göttingen to explore the lives and physics of Einstein, Planck, Born, Sommerfeld, Pauli, Heisenberg, and Schrödinger. Besides various visits to museums, the Spartans visited the apartment where Einstein wrote the 1905 papers, the patent office where he worked, the ETH and the University of Zurich where several of the course protagonists studied and taught. The class also traveled to the observatory and Einstein tower in Potsdam as well as Einstein's summer cottage in Caputh.

The classwork assigned had students reading original research literature, writing essays, giving presentations, and writing journal assignments. Besides historical places, a visit to the laboratories of the ETH rounded off the studies of "Modern Physics". More than 100 years after its inception, much of the "quantum weirdness" has become measurable reality, where you can for example follow single electrons tunneling through nano-structures.

For several of the students, this had been their first visit overseas. More than one student wrote in the course evaluation that the experience was "life changing." The wonderful scenery, cities both quaint and metropolitan, and the general sense of adventure added an element of vacation to an intense academic curriculum. We are sure that several physics discoveries were made in the coffee houses of Zurich and Göttingen or while hiking the Swiss mountains - elements that had to be added to the academic requirements for course completion. 📍



*One of the classrooms for MSU's "History of Physics" course is Einstein's summer cottage in Caputh. Students in last summer's 5-week Study Abroad class, along with professors Catherine Westfall and Gerd Kortemeyer who led the course and Wolfgang Bauer who was also in Germany and served as guest lecturer for the day, posed for this picture at the cottage.*

## Nuclear Physics Meeting Hosts Physics Olympiad



Michigan State University hosted the annual fall meeting of the Division of Nuclear Physics of the American Physical Society on October 26-29, 2011. In addition to workshops and symposia, the meeting featured an outreach component where a Physics Olympiad was held for mid-Michigan high school students. The event attracted a large number of enthusiastic students. 📍



## Join Us in Welcoming These New Faculty

**C**hris Wrede joined the faculty in August as an Assistant professor and a member of MSU's National Superconducting Cyclotron Laboratory. He is a Finnish-Canadian experimental nuclear physicist interested in the connections between nuclear physics, astrophysics, and particle physics.

Prior to arriving at MSU, Wrede was at the Center for Experimental Nuclear Physics and Astrophysics (CENPA) at the University of Washington. He completed his PhD at the Wright Nuclear Structure Laboratory (WNSL) at Yale University and his M.Sc. at TRIUMF, Canada's national laboratory for subatomic physics. At TRIUMF and WNSL, Wrede's research focused on explosive nucleosynthesis involving unstable reactants in classical novae. Wrede continued this research at CENPA with postdoctoral work on classical novae and broadened his interests to include low-energy searches for new physics.

At NSCL, Wrede and his research group will measure the beta decays of proton rich nuclides to further constrain the nuclear reaction rates that influence novae. In some cases, these experiments will simultaneously provide precise nuclear data that will contribute to low energy searches for new physics. 📍

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*Chris Wrede*

**A**lex Levchenko joined the faculty in August as an assistant professor. Originally from the Ukraine, he received his bachelors and masters degrees from Kharkov National University and his Ph.D. from the University of Minnesota. He served as a research assistant in



*Alex Levchenko*

the theory division of the Institute for Radiophysics and Electronics studying magnetic instabilities in high-Tc superconductors and his thesis was on the transport properties of low-dimensional mesoscopic conductors focusing on the interplay between interaction and fluctuation effects.

Levchenko did his postdoctoral research in the materials science division of Argonne National Laboratory where he was involved in studying transport properties of underdoped cuprates and transport of electrons in the nano-scale.

Since joining MSU last fall he is building his research group and already has a graduate student, Mengling Zhang, who is working on transport anomalies in superconductors near the quantum critical points. Two postdocs will join his group later this year to study quantum kinetics of one-dimensional electrons. He and his wife Polina are enjoying the East Lansing community as she works on her PhD thesis on intercultural marriages and they raise their young son Ilya. 📍

[levchenko@pa.msu.edu](mailto:levchenko@pa.msu.edu)



**M**orten Hjorth-Jensen joined the faculty in January 2012 as a professor and as a member of MSU's National Superconducting Cyclotron Facility (NSCL). He is a member of the NSCL theory group.

Hjorth-Jensen received his PhD from the University of Oslo in 1993, and he has shared appointment between MSU and the University of Oslo.

His research interests include computational physics and computational quantum mechanics for nuclear physics. The main focus is on many-body methods for nuclear structure problems where the aim is to understand the stability of nuclear matter in terms of the underlying forces and particles of nature. In particular, the role and understanding of many-body forces in nuclei and nuclear matter play an essential part in his forthcoming research plans. The various many-body methods can also be applied to other many-particle systems, like the structure of quantum dots.

Hjorth-Jensen is also interested in the mathematical properties of various many-body methods, in particular to develop proper error estimates when truncations are made. In essence, his research can be summarized under the topic studies of algorithms and methods for solving Schrodinger's equation or Dirac's equation for many interacting particles. 📍

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*Morten Hjorth-Jensen*

## Zhang Receives DOE Career Award

The US Department of Energy awarded Pengpeng Zhang, assistant professor of physics, an Early Career Research Award – a five-year award providing support to outstanding researchers during the early years of their careers. Zhang was among 69 scientists selected from 1,150 applicants for the awards.

Zhang's award will fund research into the use of molecular self-assembly to modify the electrical properties of silicon nanomembranes. Understanding these nanomembranes might lead to advances in organic and molecular electronics.

The DOE's Early Career Research Award is a newly introduced program to foster development of research programs in use-inspired Energy Science. The 2010/2011 competition was across all disciplines and included academic and DOE laboratory applicants. MSU did very well in this competition with two awards, one to Dr. Zhang and the other



*Pengpeng Zhang*

online at <http://science.energy.gov/early-career/>.

The objective of Dr. Zhang's project is to use silicon (Si) nanomembrane, a well controlled two-dimensional single crystalline semiconductor, as a prototype system to explore the mechanistic basis of electronic interactions at the hetero-interface and to develop strategies to tailor nanomembrane transport properties by surface functionalization and self-assembly. Understanding and

to Dr. Tom Hamann in the Chemistry Department. The awards provide \$750,000 in research support over five years, and the full list of awards is available

control of hetero-interfaces between organic and inorganic materials is crucially important for the development of organic electronics, molecular electronics, molecular/biological sensors, and energy converting devices. However, an atomic- and molecular-level understanding of charge transfer behaviors at the interface and how they influence the properties of inorganic materials remains elusive.

This work exploits the precision of molecular assembly on Si nanomembranes and combines the scanning probe microscopy characterization of local interfacial electronic structures with the electrical transport measurements of nanomembranes to elucidate the interfacial phenomena. The fundamental insights provided by this research may lead to the rational design of nanomaterials with controlled properties via regulation of surfaces and interfaces. ♣

## 3 New AAAS Fellows

Three department faculty members recently earned national recognition by being named AAAS Fellows by the American Association for the Advancement of Science:

- ♣ R. Sekhar Chivukula, associate dean of the College of Natural Science and professor of physics,
- ♣ Megan Donahue, professor of astronomy, and
- ♣ Elizabeth H. Simmons, dean of Lyman Briggs College and professor of physics.

Election as a Fellow of AAAS is an honor bestowed upon members by their peers. Fellows are recognized for meritorious efforts to advance science or its applications. Nearly 540 AAAS members were selected as fellows for 2012, including nine from MSU. ♣

## Benenson Receives Award for Continued Service

Walter Benenson, University Distinguished Professor Emeritus, received the MSU Faculty Emeriti Association "Outstanding Contributions by an Individual" Award in 2011.

Benenson, one of the first experimental nuclear physicists at the original cyclotron laboratory, received the award for his outstanding contributions to Lyman Briggs College. Since retiring in 2008, Benenson has continued to work at Lyman Briggs College and helped teach and revise the lab-based curriculum. He acts as a mentor to younger faculty and holds individual tutorial sessions with undergraduate students. He has also presented innovative "studio



*Walter Benenson*

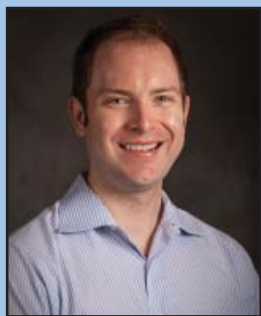
physics" sessions at MSU's Grandparents University. He remains an active senior member of the college, serving on promotion and tenure advisory committees, helping with searches, contributing to annual faculty evaluations, and adding broader perspective to discussions at faculty meetings.

The Faculty Emeriti Association Outstanding Contributions by an Individual Award is presented annually to an individual who has done an outstanding job in serving the University through contributions to a unit or program. ♣



## Fisher Presents Findings That Higgs May Be Cornered

Assistant Professor Wade Fisher was recently quoted in the New York Times and other media as he presented findings at a physics conference in Italy indicating that scientists have the Higgs boson in their sights.



Wade Fisher

Fisher, who coordinates the Collider Detector at Fermilab and DZero teams at the Department of Energy's Fermi National Accelerator Laboratory, however, suggests the elusive Higgs boson may nearly be cornered.

"We see a distinct Higgs-like signature that cannot be easily explained without the presence of something new," Fisher said. "If what we're seeing really is the Higgs boson, it will be a major milestone for the world physics community and will place the keystone in the most successful particle physics theory in history."

The results, which have been collected over several years at Fermilab, are similar to those found by teams working at the Large Hadron Collider at CERN.

Fisher is co-convenor of both the DZero Higgs physics group and the Tevatron New Phenomena/Higgs Working Group at Fermilab. This team of Tevatron researchers

together coordinate the statistical combination of results from the CDF and DZero Higgs searches.

CDF is an international experiment of 430 physicists from 58 institutions in 15 countries. DZero is an international experiment conducted by 446 physicists from 82 institutions in 18 countries. Funding for both experiments comes from DOE's Office of Science, the National Science Foundation and a number of international funding agencies. 📌

## Journal Features Lab Rankings Database

The work of Professor Michael Thoennessen and several of his students was featured in the journal *Nature* last fall as the scientists devised a method of ranking the prowess of researchers and institutions when it comes to discovering nuclear isotopes. They put together a database that included more than 3,000 isotopes and included the discovery of each by researcher, lab and method. The database ranks labs and researchers, as well as tracking how a nation's investment in nuclear technology has affected where and how the isotopes were discovered. According to their list, the Lawrence Berkeley National Laboratory is first with 634 isotopes. 📌

## Hartmann Serves on NRC/NAS Committee

Professor William Hartmann is serving as a member of the United States Liaison Committee for the International Union of Pure and Applied Physics. The Committee is an arm of the National Research Council/National Academies of Sciences. Hartmann's term on the committee will run through 2014. 📌

## Brock Named University Distinguished Professor

Raymond "Chip" Brock was one of ten MSU faculty members named University Distinguished Professors in recognition of their achievements in the classroom, laboratory and community.

The designation is among the highest honors that can be bestowed on a faculty member by the university and no more than ten are selected each year. Brock joins other department faculty, both past and present, who have this recognition, including Tim Beers, Wolfgang Bauer, Brad Sherrill, Gary Westfall, Sam Austin, Walter Benenson, Henry Blosser, Konrad Gelbke, Edwin Kashy and Michael Thorpe. 📌

## Grant Examines Localization of Sound

Bill Hartmann received a \$1.3 M grant from the Air Force Office of Scientific Research for theoretical research on mammalian binaural hearing and experimental research on human localization of sound.

Hartmann is studying the localization of sounds by human listeners in free field and in rooms. The research aims to show how sounds which are hard to localize because of room reflections can be better localized by moving around. The technically challenging experiment will track listener head motion in time while measuring signals in ear canals. 📌

## Simmons Named Woman Physicist of the Month

The APS Committee on the Status of Women in Physics recognized Professor Elizabeth Simmons as the Woman Physicist of the Month in February.

Simmons is the Dean of MSU's Lyman Briggs College. Her work in theoretical particle physics focuses on electroweak symmetry breaking, with a recent emphasis on Higgsless physics at the LHC, and on phenomenology at the LHC.

The recognition from CSWP is part of a new program to highlight exceptional female physicists who have positively impacted other individuals' lives and careers. 📌





## Relics Show at Abrams Produced by Students and Faculty

**R**elics of the Big Bang is a new planetarium show produced by MSU students, faculty, and alumni in collaboration with Abrams Planetarium. The show debuted in October.

Funded by a grant from the National Science Foundation, *Relics of the Big Bang* takes

viewers on a journey of exploration through the unknown mysteries of the universe, providing a revealing look at some of the cutting edge discovery work taking place today.

Emphasizing research currently underway at CERN, the show illustrates

the monumental scale of the Large Hadron Collider, a project that extends from Geneva, Switzerland, to East Lansing, Michigan.

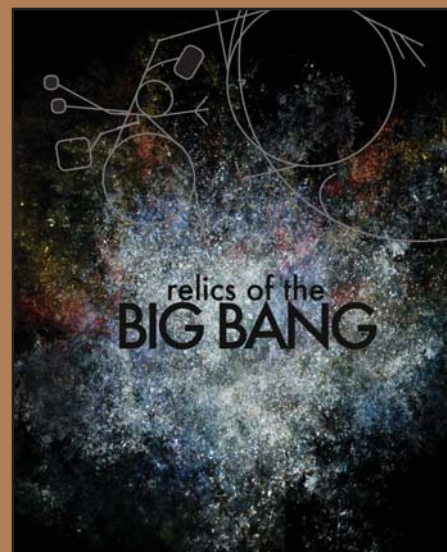
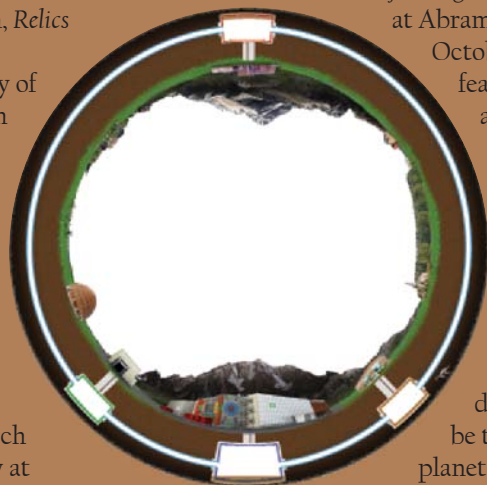
The show provides a closer look at the Large Hadron Collider and the ATLAS detector while covering Dark Matter,

the Higgs Particle, and other fascinating physical mysteries. The show features MSU research and researchers, both in the Department of Physics and Astronomy at MSU and on location at CERN.

*Relics of the Big Bang* has been running at Abrams Planetarium since October 2011. It has been

featured in local media and in several special events, including for the Capital Area Astronomy Club and the Science Theater. The show is currently being updated for international distribution and may be traveling to other planetariums.

The Large Hadron Collider is running successfully and the ATLAS experiment has started to analyze data in an effort to identify proton collisions that result in the creation of a Dark Matter particle or a Higgs Particle. MSU students, postdocs, staff and faculty are currently analyzing the data. ♡



Above: The graphic from the poster promoting *Relics of the Big Bang* hangs in the planetarium and in places across campus.

Left: The full-dome view of a planetarium image of the LHC accelerator ring with its four detector locations. In the front (i.e. the bottom of this image) is the ATLAS detector underground and the ATLAS control room above ground, with the Alps in the background.

## Summer Research Experience for Undergraduates

The department continues its 10-week summer Research Experience for Undergraduates (REU) program which is funded by the National Science Foundation, the National Superconducting Cyclotron Laboratory and Michigan State. Each summer, up to 15 undergraduate students gain research experience in physics by carrying out specific projects under direct supervision of faculty and NSCL staff.

The REU attracts sophomores and juniors from across the country. Students participate in experimental and theoretical projects in accelerator physics, acoustics, astronomy, astrophysics, atomic physics,

computational physics, condensed matter physics, high energy physics, low temperature physics, materials science and nuclear physics.

A series of lectures give students a broad perspective on current research directions and the opportunities available for careers. At the end of the program, students write a report on their project and make a fifteen minute oral presentation. Students receive a stipend plus housing and travel. ♡



Students in the 2011 REU program take a break in the courtyard between the NSCL and Biomedical & Physical Sciences Building.





# Facility for Rare Isotope Beams Ready for Civil Construction

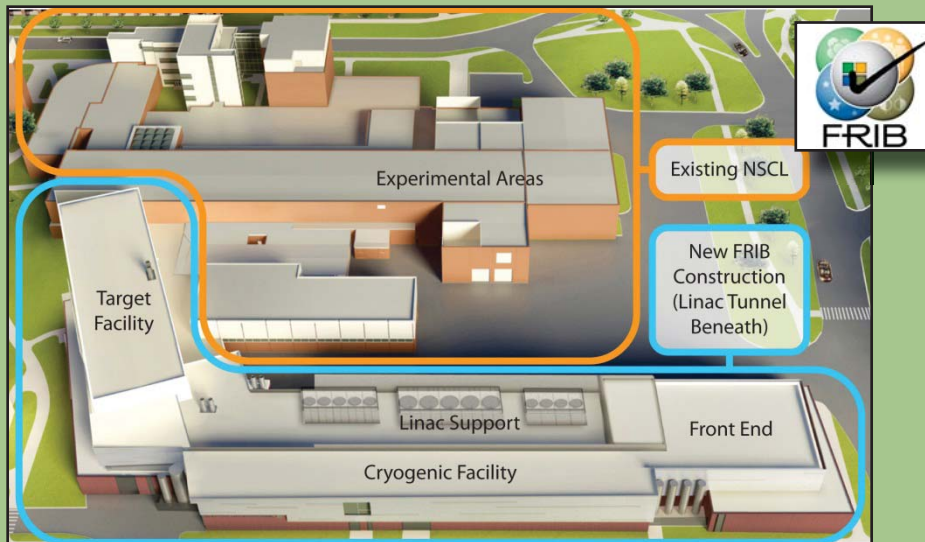
The Facility for Rare Isotope Beams (FRIB) at Michigan State University is poised to take its next big step. The project, awarded to MSU in 2008 by the U.S. Department of Energy Office of Science (DOE-SC), is ready to establish a baseline for cost, scope, and schedule, and to begin construction of conventional facilities.

FRIB will be a national user facility for nuclear science, funded by DOE-SC, MSU and the State of Michigan and operated by MSU. FRIB will be the world's most powerful rare isotope research facility, providing intense beams of rare isotopes (short-lived nuclei not normally found on Earth) for research. FRIB will enable scientists to make discoveries about the properties of these rare isotopes in order to better understand the physics of nuclei, nuclear astrophysics, fundamental interactions, and applications for society.

An independent review conducted by MSU in March found that the FRIB project is ready to establish a project baseline, the project management systems and procedures are in place, strong management and technical teams are in place, the design is at or beyond the required maturity, and the project is ready to commence construction of the conventional facilities. A

review by DOE to evaluate the proposed project baseline and readiness of FRIB to begin civil construction is scheduled for April 24-26, 2012.

Utility relocation and other activities to prepare the site for start of construction are ongoing and continue on schedule



Civil construction for FRIB is expected to begin in fall 2012 pending approval from the U.S. Department of Energy Office of Science.

for completion this spring. Final design of the conventional facilities has been developed and integrated in close coordination with technical divisions. FRIB has also made energy efficiency a priority in the design and engineering process through a combination of conservation, efficiency, and recovery efforts to support MSU's plan for a renewable energy future.

When construction starts, a tunnel 550 feet long, 70 feet wide and 15 feet tall will be built and covered by 25 feet of soil to house the new linear accelerator at the heart of FRIB. Support buildings will be

at grade level over the tunnel and, with a new target and fragment separator area, will connect to the existing NSCL to create FRIB. Pending approval from the U.S. Department of Energy Office of Science, civil construction for FRIB is expected to begin in fall 2012. The final design of technical systems will continue for another two years.

This schedule is based on a revised funding profile agreed to between MSU and DOE-SC following a 2012 congressional appropriation of \$8M less than planned and an announcement in February that the President's budget request for fiscal year 2013 contained \$22 million for FRIB—less than the \$55 million in the funding profile previously agreed to between DOE-SC and MSU. A new funding profile has been agreed to, extending the expected project completion date to 2021 (the project manages to an early completion in 2019). The budget for FRIB remains subject to annual Congressional appropriation.

FRIB will be ready to provide scientists with the opportunity for discovery on its first day of operation. An engaged and excited user community is preparing for that opportunity. More than 1,200 registered users are part of the FRIB Users Organization, representing scientists from across the U.S. and around the world who plan to develop new technology for FRIB and conduct scientific research at the facility when it is established on MSU's campus.

Visit [frib.msu.edu](http://frib.msu.edu) for more information about the Facility for Rare Isotope Beams. 🌐



Work is ongoing to relocate steam tunnels and other utilities from under the footprint of future FRIB buildings. Other activities to prepare the site for the start of civil construction continue on schedule for completion in April 2012.

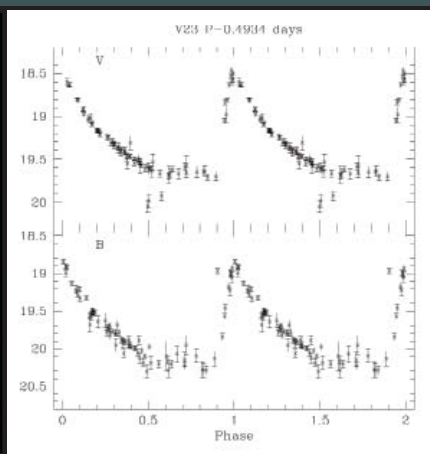
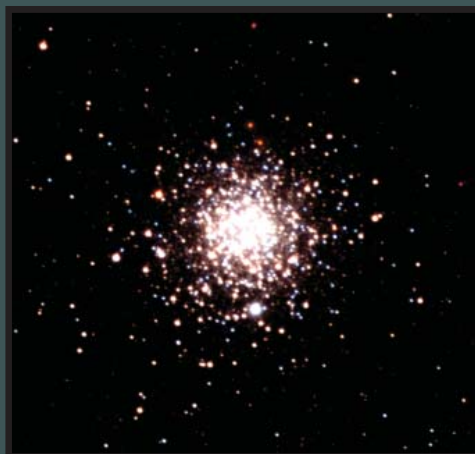


## Ancient Pulsating Stars Tell of the Formation of the Milky Way

One of the major questions in astronomy is what was going on 12 or 13 billion years ago when the Milky Way Galaxy began to form. Current theories propose that large galaxies form and grow by accreting smaller galaxies and galaxy fragments. Astronomers are currently trying to learn what these building blocks of our galaxy were like by examining the remaining small galaxies that orbit the Milky Way.

For his MSU doctoral thesis, Charles Kuehn worked with Professor Horace Smith and used the SOAR 4-m telescope to examine ancient pulsating stars in star clusters of the Large Magellanic Cloud, a companion galaxy of the Milky Way visible only from southern observing sites.

The clusters they examined are more than 10 billion years old and contain many stars that have gone beyond the stage of central hydrogen burning represented by the Sun. Some of these evolved stars are red giants and others are bluer stars fusing helium into carbon and oxygen within their cores. Among the latter are the RR Lyrae stars - giant pulsating



**Left:** Observations obtained with the SOAR telescope have been combined to make this color image of an old star cluster in the Large Magellanic Cloud. Red giants and blue core helium burning stars are visible. **Right:** This giant RR Lyrae star changes in brightness by a factor of 2.5 every 12 hours, as shown by these SOAR telescope observations.

stars that change by a factor of two in brightness two or three times a day.

Comparing the properties of RR Lyrae stars found in star clusters in the Milky Way to properties of these stars found in star clusters in the Large Magellanic Cloud can shed light on whether galaxies like the Magellanic Clouds were the stuff from which our galaxy was built.

Measurements of brightness of RR Lyrae stars in the clusters of the Large Cloud reveal some striking differences between the RR Lyrae stars they contain and those in Milky Way star clusters. If early in its history the Milky Way gobbled up dwarf galaxies, those galaxies must have been in some ways different from the dwarf galaxies that still linger around our home galaxy. 📍

## Rare Isotope Time Trial Gives Insight to Neutron Star Heat Source

The recent measurement of the mass of the short-lived rare isotope manganese-66 has made it possible for nuclear astrophysicists to pin down the underlying heating elements of one of the universe's most fantastic phenomena—accreting neutron stars.

Some neutron stars sit close enough to a neighboring star for its immense gravity to begin pulling matter from its neighbor into its own mass in an ongoing thermonuclear process. When the fuel for the neutron star is exhausted, it begins to cool rapidly. Through observations of this cooling process and measurements taken at nuclear physics laboratories such as the National

Superconducting Cyclotron Laboratory (NSCL), scientists can deduce the inner workings of neutron stars.

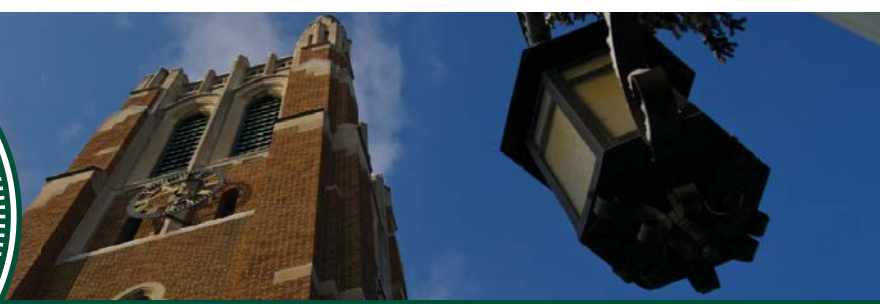
In the recent experiment at NSCL, researchers measured the mass of manganese-66, which sits right next to iron-66 on the nuclear chart. Based on the newly discovered mass and previous measurements of iron-66, scientists can determine where in the crust of a neutron star the layer of iron-66 lies, which is one of two heating elements in neutron stars.

By identifying manganese-66 and measuring the time it took to run the course, the scientists could determine its weight to within one part in 100,000.

The resulting mass was different than what theorists had predicted for the rare isotope, which changes the models of how neutron stars are structured.

“The mass difference between iron-66 and manganese-66 allows us to determine the depth needed to induce the heating reactions and therefore the location of the heat source associated with this reaction inside a neutron star,” explained Hendrik Schatz, nuclear astrophysicist at NSCL and Principle Investigator for the Joint Institute for Nuclear Astrophysics (JINA), who worked on the paper along with Milan Matos, a postdoctoral researcher at Louisiana State University stationed at Oak Ridge National Laboratory. 📍





Henry Darlington ('49) is 85 and continues to provide engineering advice and consulting with regard to audio and video systems for a large Presbyterian church in Southern California.

Jack Beal (MS '62, Ph.D. '64) is still actively working full-time as Professor and Dean of the School of Engineering at Fairfield University in Fairfield, Connecticut.

Raymond Krisciokaitis-Krisst (Ph.D. '65) is still active as a physicist with interests in particle physics/cosmology and gravitation and is also owner and president of Energy Transfer Systems, Inc. He also remains a Senior Director of the Board of Baltic New England Development Network, Inc. where he is a cofounder, former CEO and Chairman.


Robert Zuidema (M.S. '72) is retiring after teaching physics the past 24 years at Grand Rapids Christian High School in Grand Rapids, Michigan.

Daniel J. Inman (M.A.T. '75) is the Kelly Johnson Collegiate Professor and Chair in the Department of Aerospace Engineering at the University of Michigan.


Dan Magestro (Ph.D. '00) is a bond trader and research analyst of mortgage-backed securities at Nationwide Insurance.

Amit Patel ('02) is working on a Ph.D. in Electrical Engineering with an emphasis on applied electromagnetics and upon graduating this year will continue as an employee of a Navy Research facility in San Diego.

Matthew Goupell (M.S. '03, Ph.D. '05) is an assistant professor at University of Maryland - College Park in the Department of Hearing and Speech Sciences.


Dominic Bologna (M.S. '04) graduated law school with a dual J.D./LL.M in 2011 and is at the United States Patent & Trademark Office, working in the Optics Art Unit. 

### Alumnus Receives Award for Innovations

Alumnus Philip Zecher (Ph.D. '96) received a Wolfram Innovator Award honoring his significant contributions through the innovative use of Wolfram technologies. As the Chief Risk Officer at EQA Partners, Zecher designed, developed, and implemented a front-to-back trading system, from data acquisition to reporting, using Wolfram technologies. The system manages the flow of data to reduce data errors, time, and costs. Zecher is widely published in both academic journals and the financial press, and serves on the Board of Directors for the MSU Foundation. 

### Alumnus Named Distinguished Member of LLNL


Alumnus Bruce Remington (M.S. '81, Ph.D. '86) was one of ten scientists named Distinguished Members of Technical Staff at Lawrence Livermore National Laboratory. The classification recognizes outstanding excellence with distinction while allowing the honored recipients to remain focused on delivering solutions to critical areas.

Remington joined LLNL as a postdoc in 1986 and later joined the laser program. His achievements span three major areas of high energy density physics. He performed seminal experiments in inertial confinement fusion; led the creation and development of the High Energy Density Laboratory Astrophysics project through scientific achievements and the mobilization of an international community; and pioneered the use of lasers to achieve ultra-high pressure, ultra-high strain rate conditions in solid materials, also known as Material Dynamics at Extreme Pressure and Strain Rate. 

### Graduating Seniors Awarded Zeits Fellowships

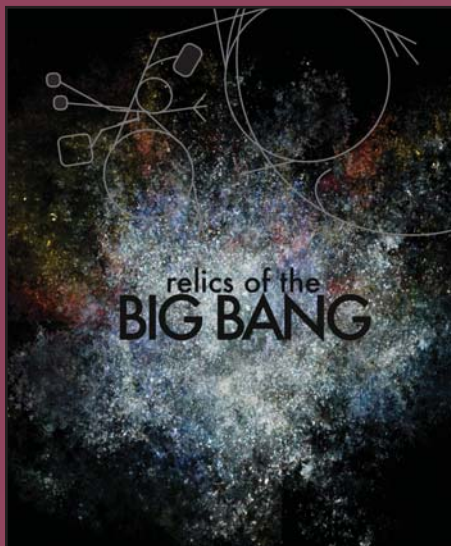
Graduating students Shea Moseby and Jeremiah Holzbauer were recipients of the prestigious Alfred J. and Ruth Zeits Research Endowment Fellowships last year. The Zeits fellowships are awarded to students with outstanding research records in LASER or nuclear science.

Moseby earned his Ph.D. with Michael Thoennessen at the NSCL this past Fall and is now a post-doctoral researcher at Los Alamos National Laboratory. Holzbauer did accelerator design for FRIB and the NSCL under the direction of Michael Syphers, and has started a post-doc appointment at Argonne National Lab.

Alfred Zeits established the endowed fellowships in 2007 to support nuclear and laser science research. He received his degree in Chemistry from MSU in 1951 and spent much of his career with General Electric. He now lives in Roseville, California. Ruth Zeits passed away in 2006. 

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*Relics of the Big Bang* was produced by MSU students, faculty, and alumni, and debuted at Abrams Planetarium in October. See page 8.



**Left:** Work is ongoing to prepare the site for the of the Facility for Rare Isotope Beams. Civil construction is expected to begin in fall 2012 pending approval from the U.S. Department of Energy Office of Science. See page 9. **Below:** The courtyard outside the department offices in the Biomedical and Physical Sciences Building.



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