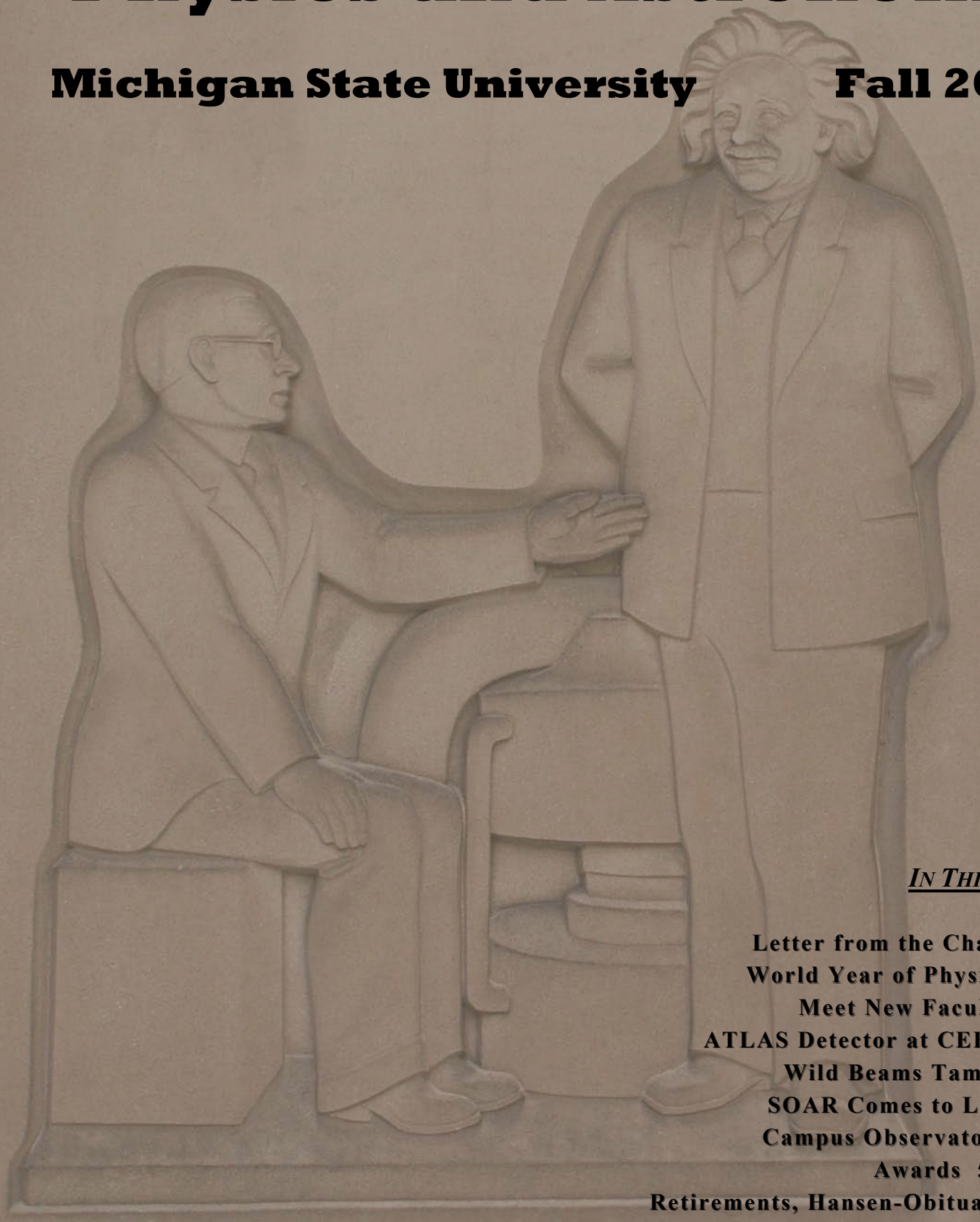
Physics and Astronomy

Michigan State University Fall 2005



IN THIS ISSUE

Newsletter
MSU Physics and Astronomy Department
Volume 7
Fall 2005

A Letter from the Chair

Dear Friends of the Department of Physics and Astronomy,

This past year was a relatively uneventful one for our department. In the spirit of "no news is good news" this meant for the first time in the last five years that the department did not have to absorb a budget cut. Consequently, we were able to keep our support staff at a constant level, adding a lot of stability to our teaching program.

Since we had hired seventeen new faculty members during the previous four years, we did not have any new faculty hires this past year. However, this is going to change in the coming year, because we have had some losses in our faculty. After over twenty years of outstanding service on our faculty, Prof. Harry Weerts has left MSU to take over the particle physics group at Argonne National Laboratory. In addition, University Distinguished Professor Walter Benenson has had his tenure home moved from Physics / Astronomy to the Lyman Briggs School at MSU, and Professor Jack Bass and Professor Gerry Pollack retired. Most sadly, Hannah Chair Professor P. Gregers Hansen died rather unexpectedly after a brief bout with cancer.

Our graduate program is growing, and this fall we have introduced the first of a new series of half-semester intensive advanced graduate courses. Professor Wu-Ki Tung has taught the inaugural class on group theory, a subject in which he is recognized as a world expert.

Our undergraduate program continues to grow as well, with ever-larger number of physics and astrophysics majors. For the first time we have had more than 50 graduates this year.

Of the numerous awards received by our faculty I will just mention the Senior Distinguished Scientist Award that Professor David Tomanek received from the German Alexander von Humboldt foundation. This foundation only makes at most 100 of these awards worldwide across all fields of academia in any given year. During the fifty years of this foundation's existence, a total of twelve MSU faculty members have received this prestigious award, and six of them are faculty members in our department.

The work of University Distinguished Professor Gary Westfall received high praise this year. The American Institute of Physics singled out the discovery of the perfect fluid of quarks and gluons as the number one physics story of the year 2005 and mentioned Prof. Westfall by name, as it was he who announced this discovery on behalf of his research collaboration during his invited talk at the spring meeting of the American Physical Society.

The SOAR telescope is starting to emerge from its engineering phase and perform at the level that we were all hoping for. Our nuclear physics group continues its push towards the Rare Isotope Accelerator and at the same time manages to run the premier nuclear astrophysics program in the nation at the NSCL. Prof. Bollen's research in atomic physics has added a new dimension, and a write-up of his first results is also included in this volume. Our condensed matter group is moving into new areas, and in particular the biophysics effort is starting to emerge. The particle physics group is preparing for the start of the LHC program at CERN.

Finally, the department also has been the beneficiary of several major donations. Randy Cowen has added $1,000,000 to his chair endowment. The Kraus Family Foundation has endowed graduate fellowships in high energy physics, and an anonymous alumnus has endowed a very generous package of a named professorship and fellowships.

In August, I was reelected as chair for another four-year term. So I am looking forward to guiding our department, which is already one of the premier physics and astronomy departments in the country, through another period of growth.

Best wishes, and thank you for your support

Wolfgang Bauer

Wolfgang Bauer
bauer@pa.msu.edu
http://www.pa.msu.edu/~bauer/

MSU Celebrates the World Year of Physics

Bernard Pope

In 1905 an obscure young Swiss patent clerk, Albert Einstein, published four revolutionary papers that shook the physics world and, eventually, led to his international fame – perhaps the most famous physicist of all time. In honor of the centennial anniversary of the *Miracle Year*, 2005 has been declared the **World Year Of Physics**. In March, members of the Department of Physics and Astronomy celebrated by inviting about 180 high-school students from the mid-Michigan area to a variety of programs in the atrium of the BPS building, the NSCL, and the Abrams Planetarium.

One of the motivations of the event was to show that physics can be fun. Visiting schools were encouraged to participate with displays or exhibits based on Einstein's celebrated papers. Various hands-on demonstrations were set up in the atrium and groups of students responded enthusiastically both to their own presentations and to those of other schools. Tours of the NSCL were organized and a special show at the Planetarium, "*The Universe of Dr. Einstein"*, was particularly appreciated. A special screening of the video program *"Nucleus Factory"* describing MSU's cyclotron facility was followed by a question and answer session with faculty and students involved in the work.

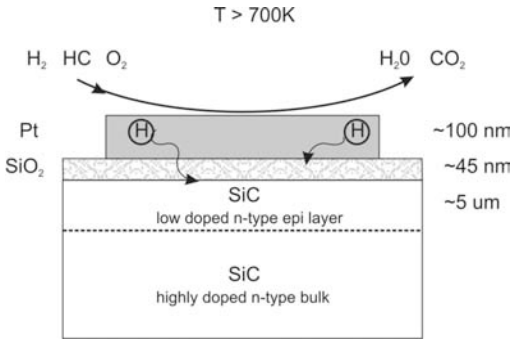
Perhaps a highlight of the day for the students was the fact that they lunched on free pizza and pop while discussing physics and astronomy with each other and with faculty and staff. They also had the opportunity to see the SOAR observing room, learn about programs at Lyman Briggs, be interested and amused by demonstrations from *Science Theatre*, and be interviewed on their scientific aspirations by a reporter from *The Lansing State Journa*l. A good day was had by all!

In the evening, a free public lecture on *"What does $E=mc^2$ really mean?"* was given by University Distinguished Professor, Walter Benenson. The talk was presented without any complicated mathematics and the audience appeared to be particularly interested and pleased to participate in a question and answer session with MSU faculty.

Meet Ruby Ghosh

Ruby Ghosh joined the condensed matter group in the Department in April 2004. She was previously a research faculty member with the Center for Sensor Materials at Michigan State starting in the fall of 1996. Ruby was a member of technical staff at Bell Laboratories, Lucent Technologies, from 1994 - 1996 and a postdoc at the National Institute of Standards and Technology. She received her Ph.D. in 1991 from Cornell University. Ruby is an experimentalist, her research program ranges from the fundamental aspects of electronic transport and optical interactions in materials to the development of solid-state devices for specific sensor applications. The two projects described below include active collaborations with colleagues at national and industrial (Ford) labs.

The wide bandgap semiconductor silicon carbide (SiC) is a fascinating material, having been generated in the atmosphere of stars for billions of years. In the single crystal form it is an indirect bandgap semiconductor with an energy gap ranging from 2.4 to 3.3 eV (depending of polytype), which allows for electronic device operation up to at least 900 °C. One of the fundamental building block of electronic circuits, the field-effect device, can be fabricated in SiC using SiO_2, the native oxide of SiC, as the insulating layer. Ruby's lab is one of the few places in the world where one can make *in-situ* measurements of charge transport in semiconductors at high temperature. As SiC is also inert in corrosive environments, she is developing gas sensors to monitor the products of automotive and energy plant combustion systems. Shown is a Pt - SiO_2 - SiC sensor for the detection of hydrogen containing species. The chemical event at the heated Pt gate, which acts as a catalyst, is detected electronically as a change in device potential. Since field-effect structures can be used to detect single electron events, Ruby is investigating the feasibility of exploiting this aspect for chemical sensitivity.



The optical properties of hexanuclear metal-halide clusters have been studied for a number of years, for example, oxygen is know to quench the bright red emission from Mo_6Cl_{12}. Absorption of ultraviolet photons raises the molybdenum chloride cluster to an excited electronic state. Emission of the red phosphorescence from the excited state is efficiently quenched by a molecule with a spin triplet ground state, such as $^3O_2$. Ruby is investigating the photophysics of Mo_6Cl_{12} and related compounds for fiber optic based oxygen sensing schemes. Quantitative detection of oxygen is important for bio-medical applications as well as real time control of energy plants. In these environments the advantages of fiber optic chemical sensors are that they be miniaturized into small flexible probes for spatial mapping and are immune to electrical interference. In contrast with the organic indicators typically used for fiber

sensors, the luminescent properties of the Mo_6Cl_{12} clusters Ruby is studying are largely immune to environmental effects, such as temperature, salinity and pH.

The ATLAS Detector at CERN

Bernard Pope

All members of the experimental high energy physics group have been actively involved in the design and construction of an enormous particle detector for several years. While some individual components were constructed in East Lansing, the detector is being assembled at the CERN laboratory outside Geneva, Switzerland. There it awaits the arrival of the world's most powerful particle accelerator, the Large Hadron Collider (LHC), scheduled for completion in 2007. The LHC will collide two proton beams with a center of mass energy of 14 trillion electron volts and the resulting collisions will release swarms of elementary particles, including perhaps some hitherto undiscovered. A particle detector relies on the precise measurement of the directions and energies of the particles produced. This is accomplished with sensitive tracking devices, electromagnetic and hadronic calorimeters, and large magnets (to bend particles and thus measure their momentum).

The first photo shows the coils of the huge superconducting toroidal magnet (there are 8 coils in total). The yellow cherry-picker gives an idea of the scale of the project. The second photo shows the team responsible for inserting the calorimeter system inside the magnet. The central calorimeter, weighing approximately 2000 tons, is the silvery object behind the group. Many of the calorimeter modules were assembled at MSU.

Wild Beams Tamed

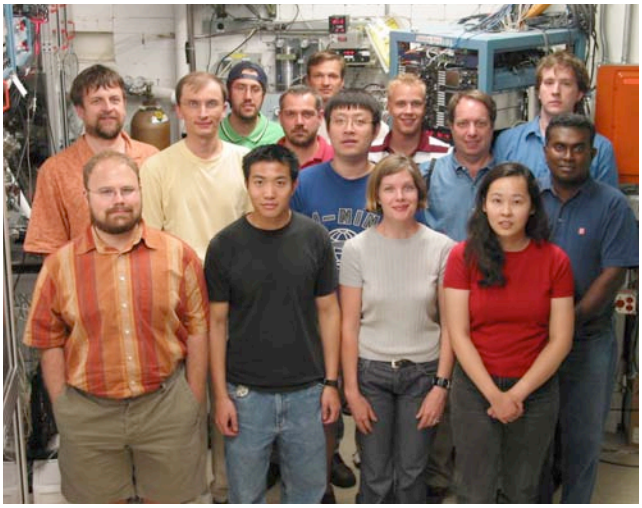
George Bollen

The low-energy beam and ion trap facility LEBIT and the NSCL gas stopper, developed by Georg Bollen (P&A) and Dave Morrissey (Chemistry) have successfully opened the door to a new class of experiments with rare isotopes from fast-beam fragmentation. After 5 years of design, construction, and commissioning, the first Penning trap mass measurements have been performed on neutron-deficient calcium, and very recently also gallium, germanium and arsenic isotopes.

The CCF delivers a large range of rare isotopes with energies of the order of 100 MeV/nucleon. Thermalizing these exotic beams and converting them into low-energy beams with excellent ion-optical qualities is the key to precision experiments with ion traps and lasers, or post-acceleration. The importance of developing a general scheme to create low-energy beams from projectile fragments has been recognized worldwide (several groups are working on it) and it is a main component of the rare isotope beam production scenario at RIA. This spring it was demonstrated for the first time anywhere that rare isotopes produced at a fragmentation facility can not only be stopped in a gas cell, but also extracted and prepared such that they can be used in high-precision experiments. The successful demonstration of the deceleration process and a first nuclear physics experiment is not only a milestone in the LEBIT project at the NSCL but an important part of future facilities like the Rare Isotope Accelerator RIA.

The first LEBIT mass measurement was carried out on ^{38}Ca which has a halflife of 440 ms. The calcium ions (~3.5 GeV) were stopped in the gas cell and extracted to form a low energy (~ eV) beam. The beam underwent a number of beam purification steps and after bunching was transferred into LEBIT's 9.4T Penning trap (left). The masses of the ions were measured with an accuracy of about 1 keV. In a second run, the ^{38}Ca measurement was repeated with better statistics and the preliminary analysis indicates that an accuracy of < 500 eV was achieved. This accuracy makes ^{38}Ca an important new candidate for the test of the conserved vector

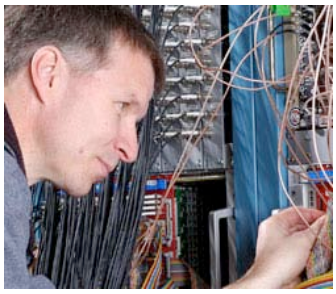
current hypothesis via the analysis of the strength of the beta decay of this super-allowed beta emitter.



In addition to ^{38}Ca, masses of a number of other isotopes have been measured in the mean time with LEBIT. A very recent highlight was ^{66}As, which has a half life of only 96 ms and is the second shortest-lived isotope ever studied in a Penning trap. Already in the first measurement by LEBIT the uncertainty of its mass value has been improved by a factor 20 compared to previous data.

Michael Thoennessen Receives MSU Distinguished Faculty Award

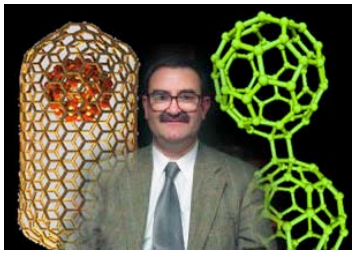
In recognition of his outstanding accomplishments in experimental nuclear physics and in playing a pioneering role in physics education, Michael Thoennessen was awarded the MSU Distinguished Faculty Award. His group at the MSU National Superconducting Cyclotron Laboratory has constructed both the Superconducting Sweeper Magnet and the Modular Neutron Array (MoNA, http://groups.nscl.msu.edu/mona/). Both devices play a central role in the NSCL's world-leading production and study of rare isotopes. MoNA involves 10 institutions, and has served as a unique model for collaboration between research universities and undergraduate institutions.



In addition to establishing an outstanding international reputation in experimental nuclear physics, Michaelhas also been one of the most popular lecturers on the Physics Astronomy faculty. He played a central role in MSU's development as a leader in on-line science education as he was intimately involved with the development of CAPA in the early 1990s, which was the precursor to LON-CAPA.

Since joining the MSU faculty in 1990, Michael has been intimately involved in nearly all aspects of the Cyclotron facility, and since June of 2003 has been the Associate Director for Nuclear Science at the NSCL.

David Tomanek Wins Humboldt Award



The German Alexander von Humboldt Foundation announced that Prof. David Tomanek, Michigan State University, will receive the prestigious "Forschungspreis", the senior distinguished scientist award. This prize is valued at up to 75,000 euro and will enable Prof. Tomanek to spend a research year at the university of Regensburg in Germany, where he will collaborate on nanoscience projects.

The Forschungspreis is awarded annually to a maximum of 100 scientists of all disciplines worldwide. Prof. Tomanek is the 6th MSU physicist and 12th MSU faculty member overall in the history of Humboldt Foundation, which was established in 1953, to receive this award. The past MSU-PA receipients of the award are Prof. Tom Kaplan in 1981, Prof. Walter Benenson in 1989, NSCL Director C. Konrad Gelbke in 1993, and Physics-Astronomy Chairperson Wolfgang Bauer in 2000. In addition, Prof. Brage Golding received this prestigious award before joining the MSU faculty.

Eduard Pozdeyev Wins APS Thesis Award

The 2005 American Physical Society Outstanding Doctoral Thesis Research in Beam Physics award went to MSU's Eduard Pozdeyev for pioneering research on space charge effects of beams in the isochronous regime.

Alumni News

We have received some news and visits from alumni and encourage more of you to do so. Since the last newsletter we can report the following:

Donald Slanina (PhD, 1969) has returned to the area and now lives in Okemos. He worked for IBM for about 30 years before his retirement in 1998 when he began to work at a teleradiology company in the Dallas-Fort Worth area. He continued with that company even after he moved to the Canadian Rockies. When he became eligible for Medicare it was time to return to this country. With both his and his wife's relatives in this area the choice to come here wasn't difficult.

Andrea J. Pepper (B.S., 1975; M.S., 1978) visited the department to admire the new building in which we now reside. She is currently the Physical Science Lab Supervisor at Perimeter College in the Atlanta area.

Richard W. Hartung died on September 6, 2005 after a long illness. Dr. Hartung had been a research scientist at MSU in the late 70s, both at the Cyclotron Laboratory and with the High Energy research group led by Wendell Chen.

The SOAR Telescope Comes to Life

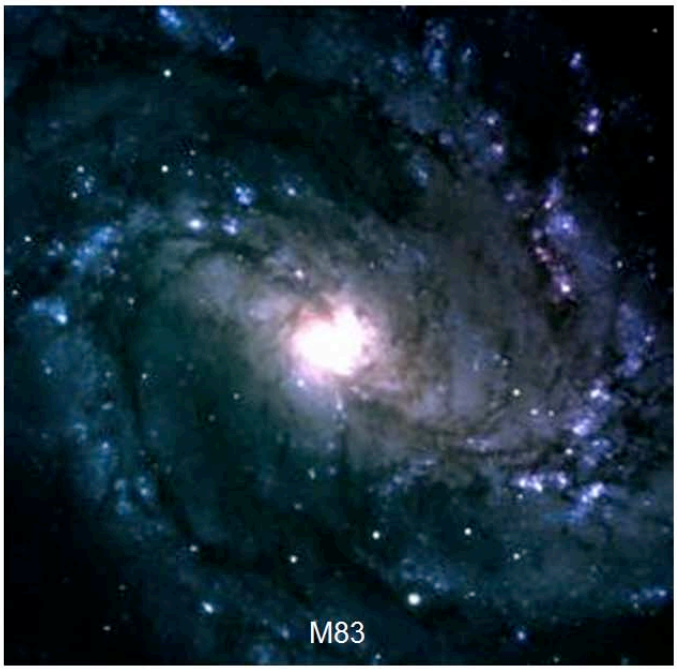
Jack Baldwin

The past year has seen great progress in the commissioning work on MSU's new SOAR Telescope. The SOAR staff in Chile has been tuning up the telescope's control system and optics, testing its suite of instruments as they are delivered one by one, and generally working through the bugs that are normal in such a complex device. Intermixed with this activity has been a series of observations of astronomical objects, which we wish to share with you on these pages.

Photo by Daniel Maturana, NOAO/AURA/NSF.

The first instrument to become available on SOAR was its Optical Imager, which uses a pair of 2048×4096 pixel^2 CCD detectors to cover a 5×5 arcmin^2 area on the sky. The color images shown here are made by combining multiple images taken at different wavelengths. In many cases, the images are for test purposes and were taken through standard broad-band filters. In other cases they are part of MSU's initial science programs on SOAR, and narrow-band filters were used to isolate specific emission lines to measure the ionization level and density of ionized gas clouds in these objects.

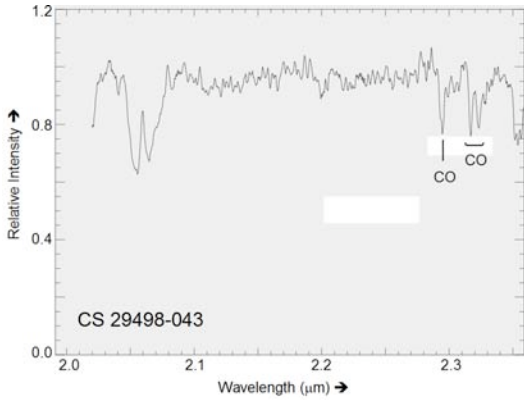
At the time of writing, SOAR's infrared spectrograph is also in operation, and MSU science data have been obtained with that instrument as well. Observations have so far been obtained for four MSU programs in this "early science" phase of SOAR's operation. The PI's for these projects are Megan Donahue (Hα Imaging of Intergalactic Gas in Giant Galaxy Clusters), Horace Smith (CCD Photometry of Variable Stars in Globular Clusters), Jack Baldwin (Narrow-Band Imaging of Nearby Star-Forming Regions), and Tim Beers (Infrared Spectroscopy of Metal Poor Stars). The data to date have been taken for us by resident astronomers in Chile, so that they can most efficiently fit the science program around the commissioning activities. This is just the tip of the iceberg that is to come. It is expected that we will start directly using the telescope ourselves around March or April 2007, with most MSU observing being done remotely from the BPS building here on campus. By the middle of next year the telescope will also be equipped with an optical spectrograph and with its premier instrument: the Spartan Infrared Camera that is



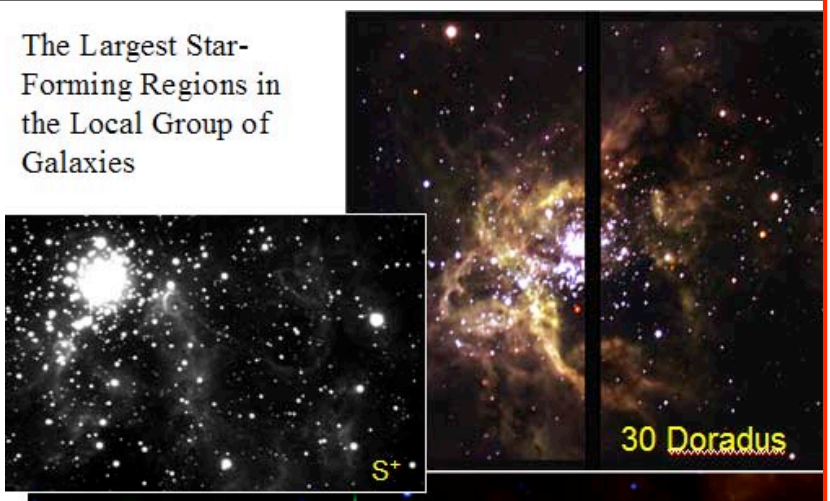
Spiral Galaxies currently appear as disks of 100 billion stars, but much of that star-formation has occurred since these galaxies were assembled from smaller units. NGC 4622 has nearly finished converting its initial supply of gas into stars, leaving the tightly wrapped, well-formed spiral arms seen in the left-hand image. M83, on the other hand, still has a long way to go in this process. The bright blue spots in its spiral arms are groups and clusters of young stars. The light from these clusters is now dominated by hot, massive stars that will only survive for a few tens of millions of years, but along with these very luminous stars, a population of less massive and longer-lived stars is forming. These less massive stars will survive for many tens of billions of years and become a smoother distribution of stars like that seen in NGC 4622. The overall process of converting gas to stars will go on for many, many generations, during which gas will constantly be recycled through stars and the proportion of heavy chemical elements will constantly be increased by the nuclear reactions inside the stars. These color photos combine SOAR test images taken through broad-band B, V and R filters.

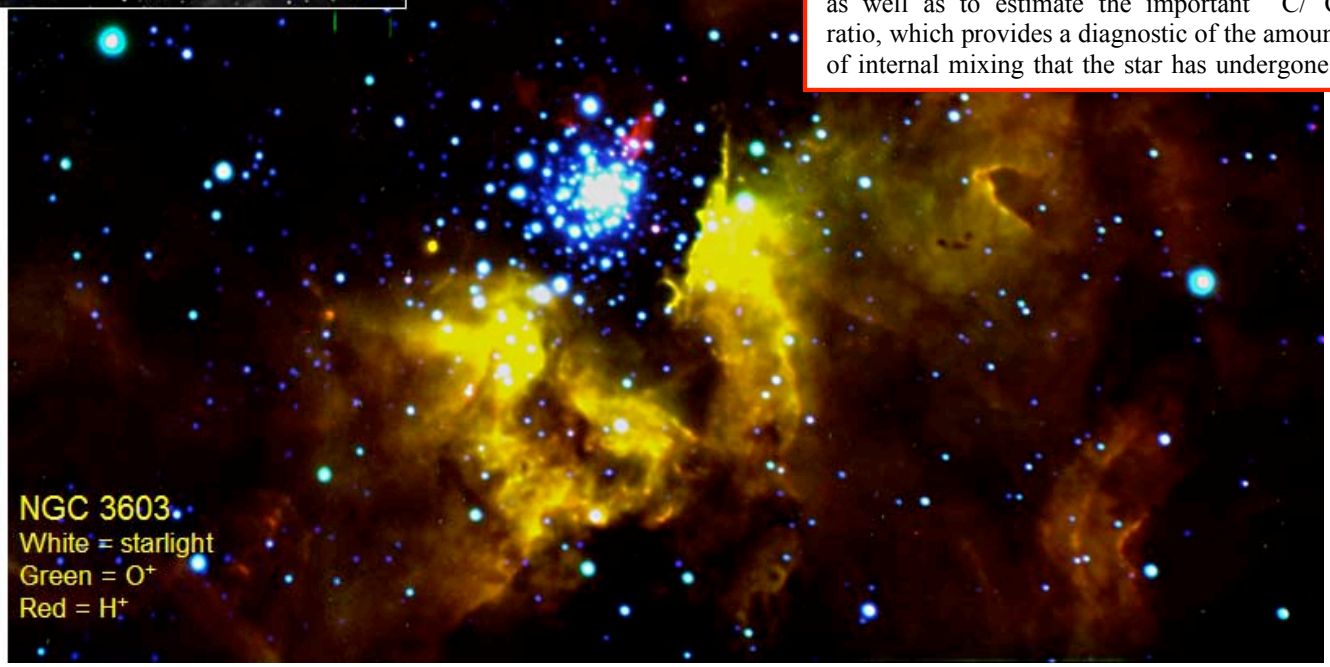
being built here at MSU under the direction of Ed Loh. With that more complete suite of instruments, SOAR will swing into its long-term role as MSU's laboratory for astronomy, with astronomy faculty and students carrying out a broad mix of observing programs reaching from the relatively nearby turf of our own Galaxy out to the most distant objects in the observable universe.

The Southern Astrophysical Research Telescope is an international project. Our partners are Conselho Nacional de Pesquisas Científicas e Tecnológicas CNPq-Brazil, The University of North Carolina at Chapel Hill, and the National Optical Astronomy Observatory. MSU's use of the SOAR Telescope is coordinated through the Center for the Study of Cosmic Evolution, which operates within the Physics and Astronomy Department. For information on how to help support our participation in SOAR, see http://www.ns.msu.edu/development/astronomy-for-all.html.



SOAR infrared spectrum of an ultra metal-poor star, taken for MSU Prof. Tim Beers and Research Associate Sivarani Thirupathi. Although the star's iron abundance is 10,000 times lower than that of the Sun, the abundance of carbon and oxygen is quite high; these elements are likely to have originated from the explosion of first-generation massive stars in the early Galaxy. The CO molecules on the right edge of the spectrum can be used to estimate the abundance of oxygen in this star, as well as to estimate the important $^{12}C/^{13}C$ ratio, which provides a diagnostic of the amount of internal mixing that the star has undergone.





30 Doradus (top) is the largest star-forming region in the local group of galaxies, while NGC 3603 (middle and bottom) is the largest such object in our own Milky Way Galaxy. In both cases, stars very recently have formed from a dense interstellar gas cloud, and the intense starlight is now heating the remaining gas and exciting line emission from its outer skin. The very most distant galaxies that we can detect are thought to be quite similar objects seen at "lookback times" corresponding to most of the age of the universe, so it is hoped that detailed studies of these nearby examples will give us insight into the very first epoch of star formation in those distant proto-galaxies. The images of NGC 3603 were taken through a series of narrow-band filters that isolate different emission lines of special interest, and represents MSU's first science data from SOAR. This is an initial step in a PhD thesis project by graduate student Eric Pellegrini, who will use SOAR's full range of instruments to study these and similar objects. According to Pellegrini, "SOAR is great! Now MSU grad students have guaranteed time on a world-class, cutting-edge instrument." SOAR will be a highly productive science facility for decades to come, with a steady flow of new instruments to keep it at the technological forefront. Many generations of MSU graduate students (and their faculty advisors) will be able to use SOAR, including for projects that have not even been imagined yet.

The MSU Campus Observatory Moves into the 21st Century

The Campus Observatory. If you have ever been out to the south end of Farm Lane, where it dead-ends into Forest Road, you might have noticed the white dome of the MSU Campus Observatory just a hundred yards or so to the west. Inside that dome is a 24-inch Boller & Chivens reflecting telescope. Since 1970 it has served for research, student training, and public viewing of the skies.

As constructed under the direction of Prof. Albert Linnell of the then-Astronomy Department, the telescope was intended to feed a giant spectrograph that would be used to analyze the light of nearby bright stars, and also to be used for photometry using the photomultipliers of the day. But under the guidance of Prof. Horace Smith, its present scientific use has shifted to imaging the sky through colored filters, to study the behavior of variable stars. Although MSU's observational astronomy efforts are now centered on the much larger SOAR Telescope in Chile, modern CCD detectors and clever observing techniques keep the Campus Observatory scientifically useful even in the face of East Lansing's frequent clouds and brightly lit skies.

An Upgrade for the 21st Century. The control system and drive motors of the Campus Observatory telescope had become quite antiquated. Under the direction of MSU's Professor Horace Smith, $144,000 in funding was obtained from the National Science Foundation to rectify the problem. A contract was sent to Astronomical Consultants and Equipment, Inc. of Tucson, Arizona to install a state-of-the-art system that provides precise computer controlled pointing and tracking of the telescope, computer-controlled movement of the dome, and a new automatic filter wheel for scientific observations. The acceptance tests were completed this October, and the transformation is remarkable. Among the conditions placed by the National Science Foundation was that the telescope should continue to be used for research, education, and outreach. MSU students have already begun to use the modernized telescope to make observations to complete their senior thesis research.

It's Open House: Public Viewing Nights. The observatory opens its doors to the public two nights per month, *weather permitting*. These open houses will start up again in April. This is your chance to look at planets, star clusters, and other beautiful celestial objects using the 24-inch telescope and also a number of smaller telescopes. Knowledgeable professional and amateur astronomers will be on hand. But come only if the sky is clear, and dress warmly.

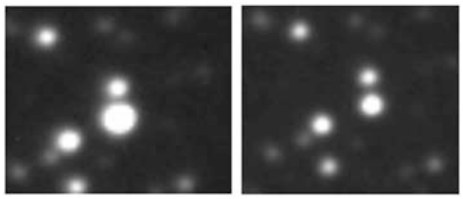
Large crowds came to see Mars during its close approach in 2003.

Photos by J. French, A. LaCluyzé & H. Smith.

Observatory readied

The final and most important component for the new MSU Observatory was installed last week. A three-ton telescope capable of magnification up to 3,200 times will help astronomical research and training. The mounting being lowered through the dome supports the new telescope. Located south of the campus off Forest Road, the Observatory will be used for an astrophysics course this summer.
–Photo by Bob Brown

From the *State News*, 1970.



Where's Waldo? This pair of images was taken two weeks apart using the 24-inch telescope. The central star is a Cepheid variable in the globular cluster M5. By measuring its brightness relative to the other (hopefully non-variable) stars in the frame, it is possible to precisely determine the variations in the light from the Cepheid even when the observations are made through thin cloud cover or in other adverse conditions. Adding modern panoramic digital detectors like the CCD used here, to an older telescope like the 24-inch, makes this type of study possible.

Elizabeth Simmons Wins ACE Award

Elizabeth H. Simmons, Director of the Lyman Briggs School of Science and Professor in the Department of Physics and Astronomy received the Michigan American Council on Education (ACE) Network's Distinguished Woman in Higher Education Leadership Award for 2005.

Dr. Simmons' research in theoretical particle physics is funded by the National Science Foundation. She has played a highly visible national leadership role in the particle theory community and was elected Corporate Secretary of the Aspen Center for Physics in 2004. Trained at Harvard and Cambridge Universities, Dr. Simmons spent a decade as a professor at Boston University before joining the MSU faculty in the summer of 2003.

Nickel-78 Half-Life Measured by NSCL/JINA

Much of the history of nuclear physics has centered on the magic numbers of nuclear structure, 2, 8, 20, 28, 50, 82, ... These are the numbers of either protons or neutrons required to make a closed shell. Doubly magic nuclei, such as ^{16}O, ^{40}Ca or ^{208}Pb are particularly important. Using the Coupled-Cyclotron Facility and the A1900 spectrometer, the NSCL was able to make the first half-life measurement of doubly magic ^{78}Ni (28 protons and 50 neutrons).

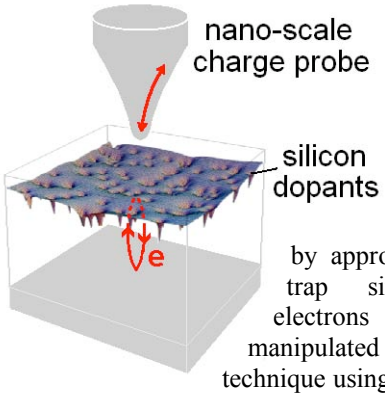
Nickel-78 is of particular importance for nuclear astrophysics as it represents a bottleneck in the r-process where heavy nuclei are created in super nova explosions. The Joint Institute for Nuclear Astrophysics (JINA, http://www.jinaweb.org) , of which MSU is a principal member, organized a workshop attended by MSU students such a Paul Hosmer, the graduate student who ran the ^{78}Ni experiment. Students learned how to model chemical evolutions of the r-process in stars, allowing them to understand the dramatic acceleration of nucleosynthesis implied by the NSCL result.

PA Senior Andrew Jones Wins Prestigious NSF Graduate Fellowship

An NSF Graduate Research Fellowship went to Andrew Jones (BS 2005). He worked with Phil Duxbury, and went to graduate school at the University of Washington.

IQS Explores Single Embedded Molecules

The MSU Institute for Quantum Sciences (http://www.pa.msu.edu/iqs) was established in 2003 to explore the mechanics of quantum systems, such as the development of quantum computers and algorithms. The Institute involves 18 MSU faculty members from the departments of Physics and Astronomy, Mathematics, and Chemistry, and emphasizes collaboration between theorists and experimentalists.



Stuart Tessmer's group has succeeded in studying the electronic properties of individual two-atom dopant molecules. The silicon molecules, embedded in Gallium-Arsenide, are separated by approximately 10 nm, and can trap single electrons. Single electrons are then viewed and manipulated with a charge-imaging technique using a probe whose tip is much like that used in Scanning Tunneling Microscopy.

The Perfect Quark-Gluon Liquid

Gary Westfall, a member of both the PA Department and the NSCL, was part of a four-person panel announcing the discovery of the quark-gluon liquid at a press conference at the APS Spring meeting in Tampa. The new state of matter was observed at the Relativistic Heavy Ion Collider (RHIC, http://www.bnl.gov/RHIC) at Brookhaven National Laboratory by colliding gold ions at ultra-relativistic energy. Researchers were surprised to find that matter behaves like a nearly perfect liquid at temperatures of 4 trillion F and at densities of $2x10^{19}$ kilograms per cubic meter, conditions at which protons and neutrons melt into their quark and gluon constituents.

Westfall chairs the RHIC User's group and is a leading member of the 619-member STAR collaboration at RHIC. Gary joined MSU in 1981 and was named University Distinguished Professor in 2004. This discovery was named top physics story of the year 2005 by the American Institute of Physics.

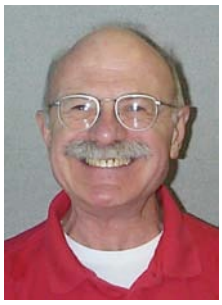
Departmental Awards

Thomas H. Osgood Award to an outstanding senior majoring in physics or astrophysics: **Andrew Jones, Sarah Lockwitz, Matthew McCaskey**; *Carl L. Foiles Award* to an outstanding graduating senior, who shows promise for graduate study: **Amanda Prinke**; *Bruce VerWest Award* to an outstanding junior: **Michaela Kopka, Alexander Stuart**; *Hantel Fellowship*: **Jacob Clifford**, **Patrick Harrington**, **Victoria Moeller**, and **Karl Smith**; *Graduate Teaching Assistant Award*: **Ji-Wu Liu**; *Graduate Teacher Award*: **Hendrik Schatz**; *Sherwood K. Haynes Award* for an outstanding student receiving a Ph.D. this year: **Daniel Bilc, Irma Kuljanishvili;** *Outreach Award*: **Walter Beneneson, Bernard Pope** for the Einstein Centennial Event; *Staff Award*: **Brenda Wenzlick, Ann Kirchmeier**; *Thomas H. Osgood Award* for Faculty Excellence in Teaching: Tenured: **Raymond Brock**, Untenured: **Megan Donahue.**

Recent Retirements

An end of an era in condensed matter physics at MSU occurred during the past year with the retirements of our distinguished colleagues, Jack Bass and Jerry Pollack.

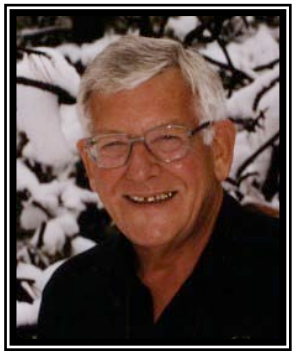
Professor Jack Bass joined the Department of Physics as an Assistant Professor in 1964, was granted tenure in 1968 as an Associate Professor, and was promoted to full professor in 1973. Jack served as Chairperson of the Physics and Astronomy Department from 1983-1988, during which time he hired 19 faculty members for the department and left his mark on the entire university. He is the recipient of numerous awards, including the MSU Distinguished Faculty Award in 1994. Retirement will enable Professor Bass to devote even more time to research.



Professor Gerald Pollack joined the MSU faculty as an Associate Professor in the Department of Physics in 1965. He was granted tenure in 1967 and promoted to Full Professor in 1969. Professor Pollack is an outstanding teacher and the winner of the P-A Department's Osgood Award for Faculty Excellence in Teaching in 1998. He most recently co-authored a junior-senior level textbook on Electrodynamics, which has become one of the bestsellers in the subject. Professor Pollack has retired to Denver, Colorado, where he plans to continue working in physics.

P. Gregers Hansen (1933 – 2005), *in memoriam*

On July 20, 2005, the Department of Physics and Astronomy and the field of nuclear physics lost one of our most distinguished colleagues. P. Gregers Hansen, John A. Hannah Distinguished Professor of Physics, died of multiple myeloma.



Peder Gregers Hansen was born on January 11, 1933 in Svendborg, Denmark. After receiving a master's degree in chemical engineering from the Technical University of Denmark in 1955, he started his work at the Niels Bohr Institute and Risø National Laboratory, first as research scientist and later as group leader. In 1965 he earned the degree Doctor of Science from the University of Copenhagen.

In 1966, Gregers was appointed Professor of Experimental Physics at the University of Aarhus and remained in that position until 1995, when he was appointed John A. Hannah Distinguished Professor of Physics at Michigan State University. While at Aarhus, Gregers invested most of his professional energy into building the experimental program with radioactive beams at CERN, where he served as the group leader of the experimental program at ISOLDE from 1969 to 1979.

Perhaps the most significant part of Gregers' research was that on halo nuclei, and in particular ^{11}Li. Gregers popularized halo-physics in four articles he wrote from 1987 to 1996 for *Nature*. At MSU, he focused in particular on one- and two-particle knockout reactions as a tool to investigate halo nuclei. He was also a world expert on statistics of experimental data and frequently contributed to the theory of this subject. Gregers' deep and lasting contributions to the field of experimental and theoretical nuclear physics were highlighted during a one-day memorial symposium held on November 5, 2005, at Michigan State University. More than 70 colleagues from around the globe took the opportunity to pay tribute to the accomplishments of a unique scientist and to celebrate the life of a dear friend.

Robert D. Spence (1918 – 2005), *in memoriam*

Our former colleague and good friend, Robert Dean Spence (BS Cornell, M.Sc. Michigan State College, Ph.D. Yale), died on January 5, 2005 at the age of 87. He was a distinguished member of the faculty of the Physics & Astronomy Department starting in 1947 until his retirement in 1985. He joined the department at the beginning of Michigan State's era of supported research in physics and in those first few years Spence, Duane Hause and Egon Hiedemann were the major supervisors of PhD students. When he produced his first PhD student in 1953 only five PhDs had come out of the Physics Department before that While he was Chair in 1956-1957 the department, with strong encouragement from the University President, John A. Hannah, embarked on a program to bring a nuclear physics facility to MSU.

Spence was both a theoretical and experimental physicist while in the department, continuing his interest in mathematical physics even while he carried out experimental

research in the new postwar area of Nuclear Magnetic Resonance. His MS and PhD students were of both areas.

He was the recipient of one of the University's Distinguished Faculty awards in 1964. After his retirement in 1985 he continued actively pursuing his interest in designing and constructing miniature steam engines. The department he left was radically different from the "physics teaching" department he first entered in 1939.

JINA Joins in A New Survey of the Cosmos

Timothy C. Beers

The Joint Institute for Nuclear Astrophyics (JINA), an NSF Physics Frontier Center involving Michigan State University, The University of Notre Dame, and The University of Chicago, has joined forces with over 25 international participants in a newly funded extension of the Sloan Digital Sky Survey (SDSS), known as SDSS-II.

The SDSS has been carrying out a massive survey of the sky using a dedicated 2.5-m telescope at Apache Point Observatory near Sunspot, New Mexico. SDSS-II will complete observations of a huge contiguous region of the Northern skies and will study the structure and origins of the Milky Way Galaxy and the nature of dark energy. The SDSS is the most ambitious astronomical survey project ever undertaken, already having measured precise brightness and position for hundreds of millions of galaxies, stars, and quasars during the last five years. The consortium of more than 300 scientists and engineers at institutions around the world are using these data to address fascinating and fundamental questions about the universe.

SEGUE will obtain imaging for another 3500 square degrees of the Northern sky in the five SDSS filters, covering lower Galactic latitudes than the original SDSS, so that detailed studies of the disk population of the Milky Way can be carried out. Of greatest significance, SEGUE will obtain medium-resolution spectroscopy of 250,000 individual stars that have been selected to sample all of the stellar populations of the Galaxy. In the future, additional observations of SEGUE stars will be made with the SOAR telescope on Cerro Pachon, Chile. JINA is particularly interested in the information that will come from the compositions of the most metal-deficient (and by inference, oldest) stars that will be found by SEGUE.

Development News

During the past year many of our friends and alumni have given most generously to the department and the university.

An alumnus of the department who wishes to remain anonymous has set up a very sizable endowment bequest, which will benefit our department. It is intended to be used for a sponsored professorship and graduate and undergraduate fellowships. The purpose is to further the participation of females in physics and to allow research on topics of societal relevance at the interdisciplinary boundaries of physics.

Randy Cowen added $1,000,000 to the endowed chair named after his late father, Professor Jerry Cowen, increasing the value of the endowment to $2.5 million.

The Krauss family (shown here are Frederick G. and Alan F. Krauss) and their Jenny H. & Otto F. Krauss Family Foundation has set up an endowment for graduate fellowships in particle physics. The first fellows will be awarded in the coming year.

Several of our faculty members (Megan Donahue, Mark Voit, Gary Westfall, Wolfgang Bauer) have donated their local royalties on sales of their textbooks to the SOAR telescope fund, pledging a minimum of $10,000 each.

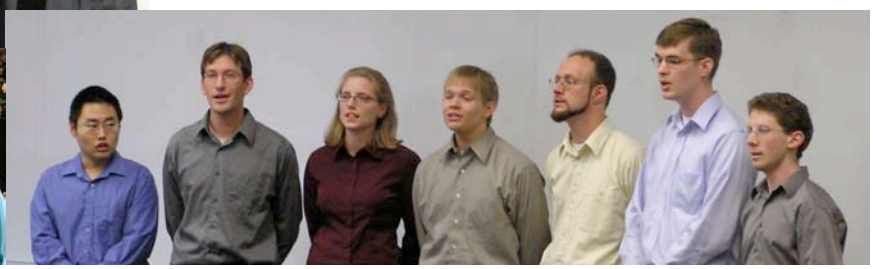
Mr. Wagner, retired elementary school teacher of Ann Arbor, has donated a bust of the famous Croat-American scientist and inventor Nikola Tesla to the MSU Physics and Astronomy Department (picture see back cover).

MICHIGAN STATE UNIVERSITY

Department of Physics and Astronomy
East Lansing, MI 48824-2320

Nonprofit Org.
U.S. POSTAGE
PAID
East Lansing,
MI
Permit 21

ADDRESS SERVICE REQUESTED



Left: spring graduation pictures; right top: Mr. Wagner donates bust of Nikola Tesla; below: inaugural appearance of the Grand Canonical Ensemble, the newly formed PA vocal group.