

Department of Physics and Astronomy
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Welcome from the Chair

It is exciting to be sharing the success of the WKU Department of Physics and Astronomy with our alumni and friends.

We have a solid core of faculty that have established research centers with visionary leadership and direction providing opportunities for research and discovery for our students, these include the:



- **Applied Physics Institute:** with the nuclear physics lab, 2.5 MeV Particle Accelerator, XRD, Nanophase Materials Center and Electronic Nose chemical detector;
- **Nova Center:** location of the Large Chamber Scanning electron Microscope, Large Area Auger spectrometer, MIRA Image Analysis Lab;
- **Astronomy Division:** home of the Institute of Astrophysics and Space Science, the Hardin Planetarium, the Robotically controlled Telescope and Kitt Peak National Observatory, Bell Astrophysical Observatory, TCCW Rooftop Observatory;
- **Cyber Defense Laboratory:** location of the 0.5 petabyte Data Warehouse, Network Intrusion Detection Lab, Network Attack Characterization Center and Telemedicine Project.

Our work at these centers focuses on student experiences in research with results that are used in conference proceedings and publications. Our centers are interdisciplinary involving students and faculty from chemistry, biology, engineering, sociology, psychology, computer science and mathematics.

We have a group of physics, engineering and GATTON students who have entered in to the NASA Undergraduate Student launch Initiative. This is a national competition to be held in Huntsville, directed by former Department Head Dr. Frank Six, to launch a NASA payload to a height of one mile and return it safely to Earth with active telemetry and launch data. We are also undergoing a major reconstruction of the University Physics Laboratory sequence introducing a more engaging, interactive and learning focused curriculum.

The inherent talent to keep this high level of activity resides with the accomplished faculty and energetic students who are in our programs. Their energy and enthusiasm keeps these projects sustainable, funded and sponsored and evolving into ever better explorations into science. On these pages we share with you some of the highlights from our most recent students and hope to stir in you some memories of the time when you were here involved in the same type of activities.

Comings and Goings

The university has grown to over twenty thousand students and the department continues to change with new students and faculty joining us this year. Dr. Roger Scott has retired after many years of service and Dr. Alexander Barzilov has moved to University of Nevada Las Vegas, Drs. Rachel and Lachlan Campbell have moved back to Australia, and Dr. Garvey accepted a position in Rhode Island. We have added Dr. Eric Steinfelds and Dr. Jason Boyles as visiting professors, Dr. Laney is the Observatory Education Scientist and Ronn Kistler is the Hardin Planetarium Coordinator. We are engaged in two tenure track searches and will see some new faculty next year and we are preparing for our program review and external evaluation as the university prepares for an accreditation review.

Professor Roger Scott retires

On June 30, 2012 long time Physics and Astronomy Faculty member Dr. Roger Scott retired from WKU. Dr. Scott arrived on campus in the fall of 1963 as a new freshman and received his BS and MS degrees in physics and worked as a WKU graduate assistant until 1970. He then went to the University of Florida at Gainesville where he worked with Dr. Alex Smith on the hypersensitization of Kodak type 103a-O plates by nitrogen baking. The final results of this research appeared in the *Astronomical Journal*, and he received his Ph.D. in astronomy in 1975. He also did work on optical variability of extragalactic radio sources as part of his post-doctoral research and teamed up with Richard and Karen Hackney for several of these studies. He was at Oxnard College in California and Ball State University before coming to WKU in 1991 as a faculty member and Director of Hardin Planetarium. Dr. Scott developed planetarium shows of everything from the solar system and cosmology to extraterrestrial life, UFOs and a well-received Star of Bethlehem holiday show. He ran a telescope workshop for over ten summers and was active in running the KY Space Grant program. His enthusiasm and love for astronomy was evident in all of his work and will continue for many more years to come.



Dr. Barzilov accepts position at UNLV



Dr. Alexander Barzilov has joined the faculty at the University of Nevada Las Vegas. Dr. Barzilov arrived at WKU as a Research Associate from 2001 – 2002 before that he was at the Institute for Physics and Power engineering in Obninsk, Russia, and at Penn State University from 2003-2004. He was a member of the Physics and Astronomy Department from 2004-2012 and was very active at the Applied Physics Institute where he has been the director since 2010. Dr. Barzilov was very active in developing research projects related to nuclear physics applications, helped to develop the MS in Homeland Security Science s program and was the Graduate Director of that program since 2008. He has remained in close contact with the faculty here and will remain a string collaborator for our students and faculty.

Welcome new telescope operator, Dr. David Laney



The department welcomes Dr. David Laney as the Observatory Education Scientist. Dr. Laney takes over from Dr. Rachel Campbell, who left last May to pursue other opportunities. Dr. Laney comes to us from Brigham Young University, where he had been managing the telescopes of BYU's West Mountain Observatory since 2009. Prior to that, Dr. Laney managed a variety of telescopes and instruments at the South African Astronomy Observatory. Dr. Laney will work with WKU astronomy faculty managing WKU's Bell Observatory and the 1.5 m Robotically Controlled Telescope (RCT) at Kitt Peak National Observatory. A consortium of universities led by WKU runs the RCT. Dr. Laney's research interests lay in the area of optical and near infrared observations of classical Cepheid and Delta Scuti stars.

Welcome new planetarium coordinator, Ronn Kistler

Ronn Kistler is the new coordinator for the Hardin Planetarium at WKU. He comes to us with a background in education and the arts. Co-author of 9 books for teachers on the process of integrating the arts into the academic curriculum, and over 45 plays for young people of all ages, Ronn has extensive presenter skills as an actor, singer, workshop leader, teacher and keynoter. He has also directed and produced hundreds of plays for and with young people. In addition to being responsible for the day-to-day operation and maintenance of the Planetarium, his duties will include helping in the design and presentation of the public shows and museum displays at the Planetarium; coordinating the visits of school children to the facility for shows and astronomy camps; and taking the workshop presentations off site to schools as part of the Planetarium's Science and Astronomy outreach program.



NOVA Center News

2012 was a breakout year for the Western Kentucky University (WKU) Nondestructive Analysis (NOVA) Center as the first industrial customers were welcomed as users of the facility. In addition to industrial, a number of academic projects were initiated in collaboration with the University of Tennessee – Knoxville (UTK), Northern Kentucky University (NKU), University of Alabama – Huntsville (UAH), and Eastern Kentucky University (EKU). A load frame capable of carrying out in-situ tensile testing is being integrated with the large chamber scanning electron microscope (LC-SEM) with the group at UTK. Initial tests on stainless steel and carbon composite dog bone as well as fiber-reinforced concrete specimens have been interrogated with the LC-SEM using the load frame. Taking us back 160 million years into the past is a group from NKU as we have been studying variety of fossilized samples including a section of a femur of a sauropod dinosaur; the jaw of a small mammal; a teeth from an allosaurus; and samples that may be a new species of iguana. Measurements on large optics were carried out with the UAH group as we looked into the feasibility of determining surface roughness in addition to the quality of the machining of the large Fresnel lenses. As a project with the fire sciences program at EKU, a student carried out a summer internship analyzing wiring that had been exposed to extreme condition while energized.

In addition to the research projects outlined above, the NOVA Center also acquired a Scanning Auger Microscope that is a unique instrument within the Commonwealth. The addition of the instrument, with an original cost of \$1.5M, will enhance the research capacity for the NOVA Center as well as WKU. The instrument is slated to come online in 2013.

Looking back on the success of 2012, the NOVA Center welcomes 2013....and the new research frontiers on the horizon!

Radio Astronomy at WKU

WKU continues to build up its multiwavelength astronomy program. In addition to involving students in his own research using radio telescopes around the globe, Dr. Steven Gibson has brought some of these tools into the classroom. Starting in 2011, the ASTR 214 General Astronomy course for science majors has included observations of natural radio emission from charged particle "storms" within Jupiter's intense magnetic field. Gibson and his students set up receiving equipment obtained from the NASA-funded Radio Jove project at Bell Observatory outside Bowling Green to capture and study these emissions.

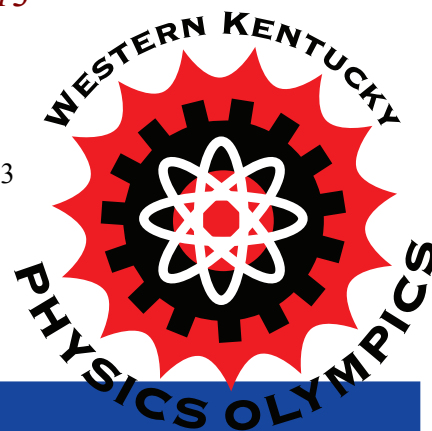


This activity revives an old WKU program of Jupiter radio monitoring dating back to the 1960s that involved many WKU faculty and students, including Frank Six, Max Robinson, Roger Scott, Richard Hackney, Karen Hackney, Jesse Burd, Bill Allen, Bruce Allen, Ed Harris, Jim Sky, and Sam Collins. (If you know more of this history, please contact Steven Gibson!) The revived program is still growing, but it succeeded in capturing short-duration Jupiter radio bursts at 20 MHz in the 2011-2012 observing season. With improved portable power supplies in the current 2012-2013 season, longer-term observations are now being made to try to capture other phenomena, including unpredictable Solar storms, and perhaps background synchrotron emission from the Galaxy in which we live.



Western Kentucky Physics Olympics – Saturday, February 23, 2013

Western Kentucky Physics Olympics is a half-day competition consisting of a pentathlon of challenging problem-solving activities that reward teamwork, creativity, and communication. The WKU Department of Physics & Astronomy invites each high school to send one or more teams of four to compete in the 2013 Western Kentucky Physics Olympics. This year's event will be held **Saturday, February 23** from 8:30 a.m. until about 2:00 p.m. in the Thompson Center, Central Wing on WKU's Bowling Green campus.



The 2013 Physics Olympics competition will commence with two activities that involve competitors arriving at the event ready to compete with things the teams have designed, constructed, and tested. The competition entitled **Bouncing Polymers** requires each team to use household ingredients to create a bouncing ball that rebounds the most when dropped from a fixed height. For **Carbonated Geysers** each team will construct a system such that a Mentos powered geyser of diet soda pop spews to the greatest height and can be aimed to fill a distant bucket as efficiently as possible. This year's "Calculation/Communication Challenge" is entitled **Molecular Isomers** and will require each team to divide into pairs and cooperatively transform one deadly molecule into an innocuous isomer form. The "On-the-Spot Activity" and "Order-of-Magnitude Quiz" will remain cloaked in secrecy until the day of the event.

Registration: Teams must register online at <http://physics.wku.edu/olympics/registration.html>. The registration deadline is 4:00 p.m., Friday, February 15.

Prizes: Each of the four contestants on the team with the best score in the overall competition will receive a \$500 scholarship to attend Western Kentucky University. The scholarship is to be used during the freshman year and is awarded above and beyond any other scholarships the student might otherwise earn. Medals for the team members and a plaque for the school will be awarded to the top 3 teams in the overall competition. Certificates will be awarded to the top three teams in each event.

Digital Projector Coming to Hardin Planetarium

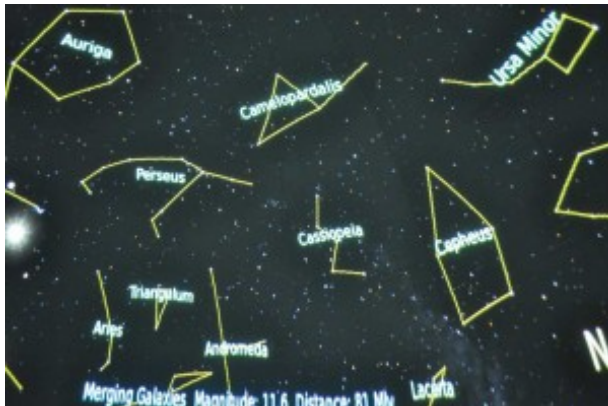
Skim the surfaces of the Moon and Mars, zoom past Saturn's rings, fly at warp speed into the spiral arms of the Milky Way, witness the formation of galaxies at the far reaches of the Universe. Then the lights come on and you're back on WKU's campus.

Welcome to the digital planetarium, an upgrade to the WKU's Hardin Planetarium that is both an exhilarating experience and a powerful educational tool. From astronomy topics to monsters of the deep sea and rockin' laser shows, the new digital software provides fun, reliable and flexible educational programs for the public, school audiences, afterschool programs, summer camps and significantly enhances the visitor experience.



Previously, the Hardin Planetarium used a mechanical "star-ball" to create points of light that mimic the night sky. "With the star-ball, we can show the constellations and the brighter stars on the sky, but you don't really get the richness of zooming into a large nebula where stars are being born," says Richard Gelderman, professor of physics and astronomy and the new planetarium director.

With the digital planetarium, visitors can 'fly' around the solar system, look at the sky as a whole, then zoom into Orion, then zoom into individual stars. It gives us many more options in terms of what concepts we can get across in an astronomy class. We can fly between stars and see that constellations are not actually groups of stars, but superpositions of stars on the sky.



Explore the Universe like never before!



Physics and Astronomy Students Present Research at KAS 2012

In October several undergraduate, graduate and Gatton Academy students mentored by the faculty in the Physics and Astronomy department presented their research findings at the Kentucky Academy of Sciences meeting held at Eastern Kentucky University and cosponsored by Berea College. They have worked closely with faculty and been mentored to be involved in the creative research endeavor and add new knowledge and results to the body of scientific knowledge. The results included research by Ellen Gamel and Wesley Ryle on Blazar Time Series analysis with Dr. Carini; Jahi Palmer working on carbon fiber cementitious materials with Dr. Kintzel; Kolton Jones examining fractures in brake rotors with Dr. Kintzel; also included with these students is work done by students from the Carol Martin Gatton Academy of Mathematics and Science: Linda Cruz working on carbon nanotube materials with Dr. Kintzel; Mary Spraggs working on Galactic interstellar clouds with Dr. Gibson; and Shane Masuda, Akhil Ghanta and Duncan Woods working on spacetime dispersion with Dr. Andrew. These students have continued the longstanding tradition of outstanding research accomplishments and engagement maintained in the department.

Society of Physics Students News

The WKU Society of Physics Students chapter had another busy year. A group visit to the U.S. Space & Rocket Center in Huntsville, Alabama in February was given a guided tour by none other than Dr. Frank Six, NASA senior scientist at the adjoining Marshall Space Flight Center and former WKU Physics & Astronomy Head (1966-1983). A separate trip in October to see the many facilities at Oak Ridge National Laboratory in Tennessee was led by WKU's own Ed Kintzel, who retains close research ties with ORNL. Individual SPS members also traveled to many research conferences during the year, including the Kentucky Academy of Science, the Southeast Section of the American Physical Society, and the American Astronomical Society.

Closer to home, the SPS assisted with sorting and distributing WKU physics laboratory manuals, provided judges elementary school science fairs, and supported departmental outreach activities like the Physics Olympics, Girls in Science Day, and Science Olympiad. The SPS also held "Physics Phun Night" social events in addition to putting on the departmental Spring and Fall picnics in city parks and helping with the annual department Holiday Lunch. And the SPS gave rise to a new interdepartmental WKU Rocket Club, which is building and testing high-altitude rockets to take part in a nationwide launch competition organized by NASA in the coming year.

The 52nd Anniversary Sigma Pi Sigma banquet recognized 7 students qualifying for induction: Aaron Bell, Andrew Gott, Jonathan King, Alexander Larin, Jonathan Newton, Lance Pauley, and Tara Wink. New officers sworn in for the 2012-2013 academic year were Jason Leszczewicz (President), Jessica Hall (President-Elect), Daniel Jones (Treasurer), and Jamey Yadon (Secretary). The WKU chapter advisor was Dr. Steven Gibson.



Student Award Winners for 2012

Each year the WKU Department of Physics and Astronomy recognizes three students who have excelled in areas of scholarship, research, and service.

Suzanna Marie Sadler received the Dr. George V. and Sadie Page Award for Excellence in Scholarship, awarded to the graduating Physics major with the highest academic standing. Suzanna, a senior physics major and Honors student worked under the direction of Dr. Lou Strolger on Type Ia supernovae and their progenitor environments. Her academic accomplishments included regular recognition on the Dean's List or President's List and membership in both the national physics honor society Sigma Pi Sigma and the mathematics honor society Pi Mu Epsilon.

John Max Wilson received the Randall Harper Award for Outstanding Research, given to the student with research exhibiting significance, effort, originality and creativity. John, a senior physics major and Honors student was involved in two major research projects. He first worked with Dr. Keith Andrew on a project that involved using Einstein's general relativity to study predictability times for "Big Rip" cosmological models. His latest project, under the direction of Dr. Ivan Novikov, is in the area of theoretical nuclear physics focusing on using Monte Carlo simulations to investigate reaction cross sections. John has begun graduate study in physics at the University of California, Davis.

Jason J. Leszczewicz, a junior physics major with minors in astronomy and mathematics, received the Douglas Humphrey Award for Outstanding Service. Jason served as President-Elect for the Society of Physics Students and was active in the Hilltopper Astronomy Club. Jason organized the student trip to the U.S. Space & Rocket Center in Huntsville, worked to design, construct, and test a trebuchet that he demonstrated at Physics Public Night and high school visits and played a major role in the Physics Olympics, Science Olympiad, and Girls in Science events. In his spare time Jason has helped with physics laboratory manual assembly, and he has recently formed a team to enter a NASA rocket launch competition.