Department of Physics and Astronomy
Western Kentucky University
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Physics on the Hill

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INSIDE:

Message from the Chair

Dr. Keith Andrew

Greetings to all of our friends! It has been an exciting and interesting year for us as the department and university continue to move forward in a number of positive ways. For the first time, enrollment at WKU topped 21 thousand students, and classes are filled to capacity to accommodate this increase. Along with this growth, we have a robust group of majors, minors and graduate students totaling over eighty students.

Our students and faculty have been very active this year: we have had them at conferences in Boston, Atlanta, Chicago, Seattle, and Austin, and they have been to specialized conferences on nanomaterials and microscopy, the American Astronomical Society meeting, the American Physical Society meeting, Women in Physics, the National Society of Black Physicists, the Kentucky Section of the American Association of Physics meeting, and the Kentucky Academy of Science meeting. They have presented on everything from distant supernovae, ballistic forensics, cosmological dark energy, multiwall carbon nanotubes, trilobite fossil element abundance, cyber encryption, exoplanets, radio astronomy, and sensor development. Although this is just a sampling, I find the topics and science compelling and exciting. The faculty have attracted motivated and driven students who make WKU a highly desirable and successful destination for science and keep physics and astronomy internationally competitive.

As always, we are pleased to hear from former students and departmental supporters, and to learn where you are, what you are doing now, and how your careers have developed after studying and preparing in our program. The Physics Olympics is coming up on Feb. 18th, and we look forward to hearing from anyone in high school interested in participating in this event. We invite you to call, write, or email at any time to let us hear from you. In general, the email address for a faculty member at Western is based on their name as: firstname.lastname@wku.edu. Send us a note, and look for our Facebook page to talk with students from any graduating year.

WKU Role in 2011 Physics Nobel Prize

The Nobel Prize in Physics was awarded this year for the discovery that our universe is accelerating in its expansion. It was awarded to the two teams that made the initial discovery, and for the crucial work in confirming the discovery, in which Dr. Louis-Gregory Strolger played a primary role. The realization of this acceleration, apparently driven by an as yet unidentified force termed "dark energy", has marked a paradigm shift in our understanding of the cosmos. The census of our universe changed substantially, with the vast majority of it composed of dark energy, and only a tiny percentage being ordinary matter. In 1998, two independent teams came to a startling conclusion-- the expanding universe was not slowing

down at all, but speeding up! To do so, the universe must have a very large, previously unseen, repellant force (or energy) acting opposite gravity, and dominating over it.

But as Carl Sagan once said, extraordinary claims require extraordinary evidence. A simple but powerful test of this apparently new cosmology was to show that in the past, when the universe was much smaller, matter actually dominated over dark energy in an epoch of deceleration. In 2004, Riess, Strolger, and a team of astronomers used the very powerful Hubble Space Telescope to show that the dark energy interpretation is correct-- the universe only recently transitioned from being matter dominated to dark-energy dominated, about 5 billion years ago. This was a crucial confirmation of the 1998 interpretations.

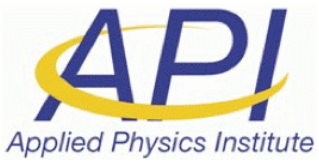
Dr. Strolger has been principally involved in this work, managing the survey as a postdoc for Dr. Riess on the Hubble confirmation study, and the primary co-investigator on a follow-up paper in 2007. He now continues his role as co-investigator on a new 3-year survey with Hubble, to assess the evolutionary nature of dark energy, and to shed more light on this dark mystery.

Applied Physics Institute

The Applied Physics Institute (API) is a multidisciplinary center performing research and development projects in the areas of nuclear physics, nuclear engineering, material science, nanotechnology, and cyber-physical systems. The API's mission is to conduct advanced research to solve real world problems, provide educational experiences to students, and advance the high tech development of the region. API researchers use fundamental physics principles to address research issues of technological importance at the frontiers of science and engineering.

The API team includes 11 faculty members, 4 staff members, and undergraduate and graduate students from several WKU departments. Physics: Drs. Barzilov, Dobrokhotov, Harper, Kintzel, Novikov, Womble. Mathematics: Drs. Kessler, Khenner, Quiton. Engineering: Dr. Wilson. Chemistry: Dr. Rathnayake.

API students and faculty are currently working on several projects, including research in fundamental and applied nuclear physics, neutron based elemental analysis, wavelet based algorithms for spectral analysis, nanotechnology based sensors, supervisory control and data systems security, and efficiency of electric energy consumption.



Selected Projects:

Fundamental Nuclear Physics: Drs. Alex Barzilov and Ivan Novikov participate in the international NPDG collaboration. The experiment to measure the parity-violating gamma asymmetry in the capture of polarized cold neutrons by para-hydrogen is performed on the Spallation Neutron Source in Oak Ridge, TN. This experiment is a high-precision measurement of nuclear forces at low energies. Dr. Novikov collaborates with Universidade de Santiago de Compostela in Spain and Petersburg Nuclear Physics Institute in Russia in theoretical studies of nucleus-nucleus interactions.

Applied Nuclear Physics: Led by Dr. Ivan Novikov, API team is developing a neutron-based underwater threat identification system. This project is funded by the National Institute of Hometown Security. Dr. Womble supervises students in studies of Doppler broadening of gamma ray peaks measured in nuclear reactions on light nuclei induced by 14-MeV fusion neutrons. API researchers are developing the radiation detectors: dual scintillation neutron sensor with digital pulse processing technique; noble gas neutron and photon detectors using electroluminescence effect.

Wavelet Based Algorithms for Spectral Analysis: In real-world applications of neutron based material identification methods, an automated gamma ray spectral analysis is needed. Led by Dr. Bruce Kessler, API researchers have started to employ a mathematical analysis technique based on wavelets that simultaneously provides quick, accurate, and objective analysis of gamma ray spectra measured using high resolution and low resolution detectors. The algorithm is the subject of a non-provisional patent pending in the U.S. Patent Office; the software package “Peaklet Analysis” that implements the algorithm has been developed.

Nanotechnology: Led by Dr. Vladimir Dobrokhotov, API team is developing the nanospring-mat based sensor (“electronic nose”) for explosives detection with collaboration from University of Idaho. The project is funded by the Office of Naval Research. Dr. Hemali Rathnayake is developing self assembled monolayers (SAM) for functionalization of gold nanoparticles. Dr. Mikhail Khenner is studying the formation of organized nanostructures from unstable bilayers of thin metallic liquids (collaboration with Drs. Sagar Yadavali and Ramki Kalyanaraman, University of Tennessee-Knoxville); the paper discussing the research results has been submitted to Physics of Fluids.

Supervisory Control and Data Systems (SCADA) Security: Led by Dr. Stacy Wilson, API team is currently developing a SCADA security laboratory. This lab will be used to test security risks and vulnerabilities in “cyber-physical” systems, as well as offer a test bed to model new technology that might prevent intrusions into SCADA systems.

Smart Thermostat and AC Cycling: Under the leadership of Dr. Phillip Womble and Dr. Jonathan Quiton, new technology to reduce energy consumption during the summer months is under development. Two systems have been designed. The first is an AC cycling switch which uses a WiFi connection to communicate with a master system that monitors temperature and weather conditions. Stochastic algorithms utilize this data to cycle AC compressors in order to reduce peak load on the electric grid. The second technology implements the switch into a "Smart" household thermostat. This thermostat gives the home owner a way of reducing energy cost.

Portable Community Infrastructure Resiliency System (PCIRS): The API researchers recently finished this project funded by the National Institute of Hometown Security. The project led by Dr.

Womble was completed with collaboration from the West Virginia High Technology Consortium and Murray State University. The PCIRS was developed to address a need for a light-weight, easily deployable transformer that can be utilized in disaster areas, whether natural or man-made. The PCIRS includes the light-weight power converter (LPC) - an electronic transformer which is comprised of solid state components reducing weight and size compared to a traditional iron-core type. The system also includes a communications package which allows remote LPC operation with satellite or cellular communication in case ground communications are unavailable. The package includes a wireless bubble allowing residents of the affected area to have voice and data service.

Waterborne Threat Interdiction (WTI): The API team led by Dr. Womble recently finished a project funded by the National Institute of Hometown Security to develop an underwater threat interdiction system. This project was completed with collaboration from the West Virginia High Technology Consortium. This project involved the design and fabrication of an underwater transducer capable of generating a 240dB (re. 1μPa) pressure wave in the water. This intense pressure wave would be used to disrupt divers or underwater autonomous vehicles that have been identified as a threat in ports or near large shipping lanes.

Homeland Security Master's Program

The goal of the multidisciplinary graduate program in Homeland Security Sciences is to prepare science professionals and technology leaders for careers in Homeland Security, an emerging cross-cutting discipline. The program is concentrated in applications of physics, biology and chemistry to Homeland Security. The program leads to the Master of Science degree and requires a minimum of 31 semester hours beyond a Bachelor degree. The program's curriculum features a hands-on research component, which enables students to apply their training to real-world problems.

HS-STEM fellowships funded by a Department of Homeland Security grant to WKU are available for incoming graduate students. The fellowship funding is $41,400 total for 1.5 years for a full-time master's student. It includes tuition and allowance $1,400/month. Each fellow must attend one Career Development Conference in Washington, D.C. during their tenure and participate in the ten-week summer research internship (travel cost is included). To be eligible for this fellowship, students must be accepted into the program, must meet DHS standards such as U.S. Citizenship, must maintain a cumulative GPA of 3.30 or higher on 4.00 scale over all academic terms, and must commit to providing at least one year of service at a DHS-approved HS-STEM venue.

Currently, three HS-STEM Fellows have started their studies in the program: Michael Davidson, Morgan Webb-Yeates, and Jason Young. We anticipate awarding seven additional fellowships during Spring 2012 and Fall 2012 semesters. Interested students are encouraged to apply.

The details about the program are available online at http://physics.wku.edu/hss/.

WKU NOVA Center

Located within the Center for Research and Development at WKU, the Nondestructive Analysis (NOVA) Center was established in 2010. Since then, the WKU NOVA Center has positioned itself as a national focal point for nondestructive measurements. At the heart of the Center is the Large Chamber Scanning Electron Microscope (LC-SEM). This instrument is unique in its design, and is the only university in North America with an instrument of this type. The NOVA Center's mission, as the ***only*** educational institution within North America with this technology available, is to provide unrivalled nanometrology, characterization, and analytical services using the LC-SEM. At an original cost of $2.7M, the LCSEM comes equipped with a suite of instrumentation that includes:

<u>High-resolution imaging</u>

Secondary Electron Imaging (SE) for topographic imaging
Back-Scattered Electrons (BSE) for elemental contrast imaging

<u>Surface characterization</u>

Energy Dispersive Spectroscopy (EDS) for chemical analysis
Fourier Transform-Infrared (FT-IR) spectroscopy for materials identification, corrosion, failure, quality control analysis

<u>Metal microstructure</u>

Electron Backscatter Diffraction (EBSD) for crystallography
Focused Ion Beam (FIB) for ion milling for subsurface examination

<u>Expanded material range</u>

Variable pressure (VP) for nonconductive surfaces

With conventional scanning electron microscopes (SEM), one of the most frequent challenges for materials scientists is the limitation imposed by the SEM chamber on sample size, typically on the order of ten to a hundred millimeters in diameter, which greatly constrains the types of samples that can be scanned. WKU's LC-SEM overcomes this and many other challenges in nondestructive analysis. The LC-SEM can accommodate samples up to 1500 mm in diameter and 650 lbs due to the size of the vacuum chamber and the Extended View capabilities of the optic system.

In addition to investigations of large samples, the LC-SEM has great potential for *in-situ* observations of deformation behavior of materials, as well as for relatively small production processes. The LC-SEM makes it possible to perform “interrupted monitoring” experiments for larger engineering parts. For example, the lubrication aspects of a typical automotive powertrain system including the engine, transmission, driveline, etc., can be investigated using this technique. The parts can be in service for a period of time followed by a tribological investigation of the surfaces in the LC-SEM, bringing them to service immediately after the investigation is completed. This way of monitoring a system opens up a wide range of engineering applications that permits a more detailed understanding of fundamental physics of these processes.

Initial transdisciplinary studies have been conducted at the NOVA center on bourbon barrels (Biology), Fiber-reinforced concrete (Engineering), Trilobites (Paleontology), Firearms and Ancient Bones

(Forensics), and Meteorites (Astronomy). Building on these initial results, we seek to expand the reach of the NOVA Center beyond the Commonwealth to include the Nation and research groups from around the world.

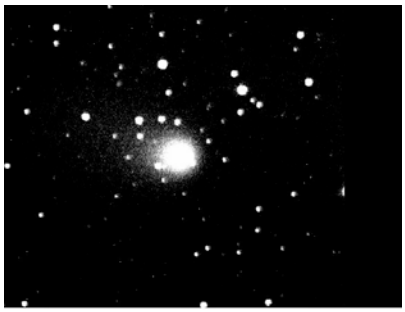
1st Annual KY Nanotechnology Symposium
Friday & Saturday, March 30-31, 2012
Knicely Conference Center, Bowling Green, KY

Bringing together micro and nanotechnology researchers within the Commonwealth of Kentucky and the South and Midwest regions, WKU is pleased to present the **1st Annual KY Nanotechnology Symposium**, to be held March 30-31, 2012 in Bowling Green, Kentucky. The symposium is open to all scientists, engineers and students from a wide range of disciplines involved in microtechnology, nanotechnology and advanced materials. The symposium will expand the awareness of core facilities that exist within the region and cultivate new research collaborations. Presentations focused on advanced material synthesis, metrology and characterization, devices, education, and facilities will highlight the symposium. Early/regular registration is $95/$110, or $25/$35 for students. For additional information, please phone 270-745-NOVA, email Ms. Dawn Wientjes [dawn.wientjes@wku.edu] or Dr. Edward Kintzel [edward.kintzel@wku.edu], or visit the department website.

Institute for Astrophysics and Space Science

It has been another busy and successful year for the faculty and students in the Institute for Astrophysics and Space Science (IASS). Dr. Steven Gibson won a highly competitive National Science Foundation *Research at Undergraduate Institutions* award to further his and his students' radio studies of cold, pre-star-forming clouds in our Galaxy's interstellar medium, and his student Jonathan Newton landed a summer internship to conduct related research at the Arecibo Radio Observatory in Puerto Rico. The 2011 Nobel Prize in Physics was awarded to a team

including Dr. Adam Reiss at the Space Telescope Science Institute. Our own Dr. Louis Strolger is a member of the research team whose work resulted in the Nobel Prize. In addition, Dr. Strolger and his undergraduate / Gatton Academy student research team have been busy using the Robotically Controlled Telescope (RCT) to observe Supernova SN 2011fe in the spiral galaxy M101. Pictured above, this is the closest supernova (inside the circle) to Earth since one was observed in 1993. In total, 16 papers have been published or submitted to the peer reviewed journals with IASS members as authors in 2011.



Speaking of our research facilities, the RCT continue providing copious amounts of data for our faculty and students. In addition to Dr. Strolger's supernova work, Dr. Michael Carini and his Gatton student Rebecca Brown have continued their studies of Blazars and are participating in an international campaign on two Seyfert galaxies. Their goal with this project is to determine the mass of the central supermassive black hole. Six undergraduate students are currently nearing the end of their training program and will be assuming observing duties at the Bell observatory in December. Bell observatory also obtained images of comet Garradd (shown to the left) on October 15, 2011.

For the second year in a row, IASS funds have supported the Cave Area Rocket Scientists Team travel to the Team America Rocket Competition (TARC). The Cave Area Rocket Scientists are a group of middle and high schools students from Hart County. This year, additional support was obtained through a proposal to the Kentucky Space Grant Consortium. The teams did very well at the national competition, both finishing in the top 100. Our support has allowed the teams to leverage the TARC experience into successful proposals to the Student Launch Initiative at Marshall Space Flight Center in Huntsville Alabama. Pictured below are the two teams at the 2011 TARC competition.

A summer planetarium show was given for the second consecutive summer in the Hardin Planetarium. The show, entitled *Venus: Our Sister Planet*, was a rousing success, drawing larger than expected crowds. We have continued our fall series of shows, with the annual *Star of Bethlehem* show premiering Nov 20. In addition, we unveiled a new planetarium display in December, called *ViewSpace*. This is an internet-fed, self-updating, permanent exhibit from the Space Telescope Science Institute, home of NASA's Hubble Space Telescope and its successor, the James Webb

Space Telescope. It provides an ever-changing kaleidoscope of presentations of the latest and most beautiful in astronomy and space-based earth science. This represents the beginning of a major overhaul of our planetarium displays. We have also continued our twice-monthly public nights, with one night focused on astronomy and viewing through the TCCW 12.5” telescope when conditions permit and the other night focused Physics topics using family oriented, hands on activities. In the picture on the previous page, Physics faculty member and university provost Dr. Gordon Emslie works with participants on constructing a rocket during the August 2011 Physics night.

WKU High-Altitude Balloon Program

The WKU High Altitude Research Platform (or WHARP) and its educational and research programs have begun to take flight. Since reintroducing this program in 2010, Drs. Louis Strolger and Lachlan Campbell have expanded the program's initiatives, developing classroom exercises and outreach activities, and are now introducing nascent research. Four successful flights were made over the past year, including class projects, an outreach activity with the KY Governor's Scholars program, and an effort to extract micrometeoroids and comet dust from the upper atmosphere. Owen Gaulle, a third-year physics major from the Nashville area co-leading the micrometeoroid experiment, said of the program,

> "This research is very challenging, but also very interesting. It takes a lot of work to predict and plan each flight, and a lot of time to track and recover the payloads. And after all of that, the research is only half done! I still have to take my collection sample to the NOVA Center for composition analysis, and then weigh the results of what we've collected against origin theories. But all of this work, especially with the payload recovery, requires a team of people working together, and building that camaraderie is a lot of fun."

Next year there are plans to conduct more outreach initiatives involving area middle and high-school students, and to continue experiments in micrometeoroid collection and low-gravity film growth, in collaboration with the NOVA Center.

Left: first launch, November 20, 2010. Right: balloon-camera photo looking down at science payload near maximum elevation (over 90,000 feet) during April 22, 2011 flight.

Cyber-Defense Laboratory

The Cyber Defense Laboratory in the Department of Physics and Astronomy continues to look for ways to extend the capabilities to detect cyber intrusion. Several of the research scientists presented results at the Kentucky Academy of Sciences meeting highlighting work with Electronic Warfare Associates and the Army Research Laboratory. The work from Tony Simpao, Stacy Wilson, and Phil Womble introduced a new analysis package to look at internet traffic to find anomalous network behavior. This method uses the Fourier transform of the logarithm of the spectrum of the network traffic pattern. The essential ingredients of this approach can also be used in wavelet and neural network analysis of data, and the resulting signature is similar to looking at a reversed spectrum, so the name of the plot is a rearrangement of the word spectrum into "cepstrum", and the resulting frequency-like spikes are referred to as "quefrency" spikes. The lab has also been looking at Supervisory Control and Data Acquisition (SCADA), security issues with networked systems that include the power grid and water distribution network. Physics and Astronomy graduate student Kyle Moss, in our MS in Homeland Security Sciences program, is working with Stacy Wilson from Electrical Engineering and Phil Womble, Alex Barzilov and Doug Harper in Physics and Astronomy on a SCADA security system lab test faculty as part of the API. His thesis work includes testing a local Bowling Green Municipal Utilities-inspired SCADA system for attack vulnerabilities by internet hackers. As Kyle finishes this project, he has accepted a position as a doctoral student in Electrical Engineering at the University of Louisville. Visit the WKU Cyber Defense Laboratory at: http://www.wku.edu/cdl/.

Radio Jove, Then and Now

WKU has a long history of studying radio emissions from electrons in Jupiter's magnetosphere, initiated by former Department head Frank Six (now at Marshall Space Flight Center). *Near right:* WKU's Roger Scott working on his Master's thesis on this topic in 1969 at a rural station outside of Bowling Green. *Far right:* Students Maxwell Dierken, William Roach-Barrette, and Mary Spraggs testing new Radio Jove equipment at Bell Observatory as part of Dr. Steven Gibson's Fall 2011 ASTR 214 class.

Argonne Undergraduate Symposium

Physics students present their work at the Annual Argonne Undergraduate Symposium. This October, Drs. Kintzel and Strolger accompanied 12 physics students giving talks at the Argonne Undergraduate Symposium-- a hallmark tradition for our students engaged in research. Attendance to the meeting was graciously supported in part by WKU's Society of Physics Students chapter. Interestingly, nearly all of these students were either graduates of, or currently students in, the Gatton Academy of Mathematics and Science-- a point which highlights both the success and potential of this education cooperative. The students gave well-prepared talks to the audience of nearly 300 undergraduate and graduate attendees from the region. They were also treated to tours of the impressive Advanced Photon Source, giving students a glimpse of the professional lives researchers at national facilities. Of course, a genuine highlight was the opportunity for "Real Pizza" and the chance to beat Dr. Strolger in Bowling. The participants included: Tara Wink, Suzanna Sadler, Lydia Brothers, Andrea Eastes, Owen Gaulle, Jason Leszcewicz, Andrew Gott, Ben Rice, Will Bickett, Christian Jolly, and Jamey Yadon.

Physics & Astronomy Student Awards

The following departmental awards were granted in April 2011:

* Kyle A. Curry - Dr. George V. and Sadie Skiles Page Award for Excellence in Scholarship
* Suzanna M. Sadler - Dr. Randal Harper Award for Outstanding Research in Physics and Astronomy
* Schuyler G. Wolff - Dr. Douglas Humphrey Award for Outstanding Service

Schuyler Wolff's thesis work was also named the campus-wide WKU Honors Capstone Experience/Thesis of the Year for 2011. This award is given annually to the Honors student whose CE/T project exemplifies the highest quality of research, creativity, and writing, as selected by a committee of faculty representatives from each of the colleges.

Schuyler Wolff, Suzanna Sadler, and Kyle Curry at the 2011 Ogden College Student Award Ceremony

Finally, at the 219th American Astronomical Society meeting in Austin Texas, WKU physics students Aaron C. Bell and Andrew M. Gott both won the Chambliss Astronomy Achievement Student Award, which recognizes exemplary research by undergraduate and graduate students in poster sessions at the AAS. Awardees are honored with a Chambliss medal. It is rare for an institution to garner one such award, let alone two. But WKU's Kyle Cook, now at Texas A&M, also won a Chambliss medal two years ago, so we are on a roll!

Society of Physics Students

The WKU Society of Physics Students chapter has been active this year on many fronts. In academics, the chapter ran GRE study sessions for graduating seniors and organized a career-informational visit to the Vanderbilt Medical Physics Department. Similar trips are planned in 2012 to Oak Ridge National Laboratory and NASA's Marshall Space Flight Center.

On the research front, club members participated in a large number of conferences, including the Argonne National Laboratory's Symposium for Undergraduates, the Southeast Section of the American Physical Society, the Kentucky Academy of Science, the Conference for Undergraduate Women in Physics, the National Conference on Undergraduate Research, and the American Astronomical Society.

In chapter business, the club sent representatives to the SPS Zone 8 meeting at Morehead State University and to the SPS Open Lab day at the University of Kentucky. A special treat was the club's hosting a visit by Dr. Thomas Olsen, Assistant Director of Sigma Pi Sigma and the SPS National Office, who spent the day with WKU students and gave a seminar on careers in physics, SPS opportunities, and his own research in fluid mechanics.

In public outreach, the chapter hosted multiple departmental Physics Public Nights demonstrating projectile principles with bottle rockets, trebuchets, and water balloons to great success, and also showed the club trebuchet to enthusiastic local high school groups. In addition, SPS members assisted with the annual and highly successful Physics Olympics, Science Olympiad, and Girls in Science Day events.

From left to right: Schuyler Wolff, Michael Simpson, April Pease, Jacob Baxley, John Wilson, Armin Smailhodzic, and Kyle Curry at the 51st Annual WKU SPS banquet.

Departmental social events conducted by the SPS include the 51st Annual SPS Banquet and Sigma Pi Sigma induction, in which students Kyle Curry, John Wilson, Suzanna Sadler, and Michael Simpson were added to the honor rolls of Sigma Pi Sigma national membership. The SPS also hosted the Spring and Fall picnics for faculty, staff, students, and families, as well as the SPS Thanksgiving Potluck (see fall picnic photos below). Lastly, the club regularly held Physics Fun Nights throughout the academic year, including a Physics All-Nighter on Homecoming weekend, the day before the Fall picnic.

An SPS group photo was taken for WKU's *Talisman* yearbook in Fall 2011. Officers for the 2011-2012 academic year are Suzanna Sadler (President), Jason Leszczewicz (President-Elect), Jessica Hall (Secretary), and Tara Wink (Treasurer). The SPS wishes to acknowledge the exemplary service of Dr. Doug Harper, who has stepped down from his faculty advisor role after 12 years; the new advisor is Dr. Steven Gibson.

Hilltopper Astronomy Club

The Hilltopper Astronomy Club had an exciting fall semester, being involved with the public on many levels, and brought astronomy to some members of the community who had never before had the opportunity to look through a telescope.

Physics & Astronomy Public nights continued to be popular with the local community. We had more than 100 visitors attend the 4 public nights held monthly. On clear nights participants were able to see planets, binary stars, star clusters and galaxies. Surprisingly, the cloudy nights were also well attended, with participants engaging in activities such as building their own alien and walking a scale model of the Solar System.

The HAC was also the main attraction for the "Blast-off to Fun" event held by local scout groups at Wildcat Hollow scout camp in September. This night was attended by more than 80 scouts and their families who were entertained with views of Jupiter and the recent supernova in the whirlpool galaxy as well as an indoor presentation.

The HAC hosted 2 star parties over the semester: The first party, held on October 15, was "Astrophotography of Jupiter". On this evening, several HAC members and nearly 40 families and WKU students used the rooftop telescope for a spectacular view of Jupiter and its 4 Galilean moons. Several people were able to take wonderful photographs just with their handheld cameras and smartphones. At the end of the evening a TV monitor was hooked up to the 12" telescope, allowing an amazing view of the craters on the moon, capping off a great night for viewing the sky. The second star party was held at Chaney's Dairy barn on November 18 to coincide with the Leonids meteor shower. More than 50 people attended this event, watching meteors blaze across the sky while speaking with astronomers and eating ice cream - as many of the HAC members pointed out, it was the perfect combination of food, phenomena and fun!

New Faces: Robert Duvall

When did you graduate from WKU? What did you do after that?

I started at WKU in the Fall of 1989, and one of the first classes I took was Physics and Biophysics II taught by Dr. Wieb van der Meer. I was quite impressed with his teaching style, and I felt he had a genuine concern for the students' success. This was a huge motivation for me. I had just changed my major to pre-optometry, but was still uncertain if this was the right direction. I thoroughly enjoyed Dr. van der Meer's class, and it affirmed in my mind that optometry was the way to go. Other WKU courses that had a huge impact on me were Comparative Anatomy, taught by Dr. Blaine Ferrell, and Biophysics 335, taught by Dr. van der Meer. WKU prepared me so well for optometry school that I was accepted a year early, before even completing my undergraduate degree. I finished my undergraduate requirements at WKU in 1991, and began optometry school at the University of Alabama at Birmingham in that fall. While in optometry school, I completed requirements for a B.S. in Physiological Optics. Then I received my doctorate in optometry in 1995.

When did you return to Bowling Green?

I moved back to Bowling Green in March 1995 for my externship rotation. I got to observe and participate in some local optometric practices. In addition, I spent time in retina surgical practice in Louisville. I began practicing in Bowling Green the summer of 1995, and I opened a new practice in 2008 called Precision Eye Care & Optical. From 1995 to 2009, I had the opportunity to provide guest lectures for some of Dr. van der Meer's classes, for AED (a pre-professional society), and for Unite for Sight (UFS). I have served as the optometric advisor the WKU's chapter of UFS, which is a volunteer organization charged with helping meet the vision needs of the less fortunate throughout the world. I think a quote from their website summarizes their mission very well: "Unite For Sight supports eye clinics worldwide by investing human and financial resources in their social ventures to eliminate patient barriers to eye care. Unite For Sight applies best practices in eye care, public health, volunteerism, and social entrepreneurship to achieve our goal of high quality eye care for all."

Is it not true that an optometrist does a lot of applied optics every day?

Absolutely! During the course of a given day, almost everything I do revolves around optics. When I perform the refraction to determine a patient's glasses prescription, I always use an optical device called the Jackson Cross Cylinder (JCC) to diagnose them with astigmatism. The JCC allows me to determine the magnitude and direction of their astigmatic defect. The cross cylinder is a compound lens having a net minus power in one primary meridian and a net plus power in the other meridian. This lens is flipped to give the patient two choices to determine if they have astigmatism. Once the dioptric power of astigmatism is determined, the JCC is then rotated 45 degrees away from the cylinder axis to determine the patient's axis of astigmatism. Also, I must have a properly calibrated eye chart to determine a patient's visual acuity. Using math and physics, I must ensure that the 20/20 letter on the chart subtends 5 minutes of arc on the retina. I also use prisms to diagnose and treat ocular diseases such as strabismus (when an eye turns) and heterophoria (when an eye has a tendency to turn). To evaluate the health of the eye's interior, I use a 20 diopter lens combined with a BIO (binocular indirect ophthalmoscope) to view a magnified image of the retina to rule out retinal detachments, retinal holes, retinal edema, optic nerve edema, as well as cancerous growths such as choroidal melanomas.

How much teaching have you done for WKU?

With Dr. van der Meer's encouragement, I started as an adjunct faculty member in the Fall 2010, co-teaching Physics 359 with him. We originally called the course "Biomedical Optics", but we've changed it now to "Clinical Optics". In addition to teaching the concepts mentioned above, we cover the function of the human crystalline lens and the biophysics of retinal phototransduction along with other diseases and refractive errors that effect human vision. I have enjoyed the opportunity to interact with students, hopefully teaching them some new concepts and encouraged them to think through things they might never have considered before. I look forward to continuing my time teaching in the Physics Department at WKU!

WKU Physics Olympics

The 2012 Western Kentucky Physics Olympics – Saturday, February 18th

Teams of four high school students will compete against one another in the 2012 Western Kentucky Physics Olympics, a half-day competition consisting of a pentathlon of challenging problem-solving activities that reward teamwork, creativity, and communication. 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. This year's event will be held **Saturday, February 18** from 8:30 a.m. until about 2:00 p.m. in the Thompson Center, Central Wing. Teams need to register online at http://physics.wku.edu/olympics/registration.html before 5:00 p.m., Monday, February 13.

The competition will commence with two activities that require the competitors to arrive ready to compete with devices they have designed, constructed, and tested. This year's Do-Ahead competition, entitled ***Naked Egg Transport***, requires each team to design, construct, and use a package to safely transport a shell-less egg through harrowing circumstances. For the Plan-Ahead competition, ***Submarine Maneuvers***, each team will assemble and test a submarine vessel, powered solely by mechanical energy that can descend and complete passage through a prescribed course before ascending within a target zone. The Calculation/ Communication Challenge, ***Tsunami Epicenter***, involves each team dividing into pairs and cooperatively sharing the process of determining the location of an undersea earthquake. The "On-the-Spot Activity" and "Order-of-Magnitude Quiz" will remain cloaked in secrecy until the day of the event.

Results from the 2011 Physics Olympics

Over fifty competitors from thirteen teams participated in the 2011 Physics Olympics – Power Puzzle. Four high schools were represented: Bowling Green, Greenwood, South Warren, and Warren Central. The winning team was Warren Central's Titans, coached by Kenny Lee. South Warren's Spartans, coached by Scott Cassady, came in second, just ahead of the third place finishers, Warren Central's CharLee's Angels. Each event was strongly competed, with no team winning more than one event. The winners of the five Power Puzzle events were:

Raingutter Regatta competition from the 2011 Physics Olympics

Solar Photovoltaics: Do-Ahead Project – GirlPower (GHS)
Raingutter Regatta: Plan-Ahead Project – Purples (BGHS)
Fermi Questions: Order of Magnitude Quiz – Spartans (SWHS)
Alternative Energy Generator: Calculation/Communication Challenge – ScienceClub (GHS)
Electromagnet: Impromptu Team Activity – Titans (WCHS)