
Physics on the Hill

Fall 2007, Volume 6, Issue I

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UPCOMING EVENTS

Kentucky FIRST Lego League Tournament

January 19, 2008,

Special Guest **Grant Imahara** (*Mythbusters*)

Western Kentucky Physics Olympics

The Science of Wizardry

February 23, 2008

Registration Deadline, February 20, 2008

ALUMNI PROFILES AND MORE...

WKU Physics Alumni share their experiences at Western, what they are doing now, and how WKU prepared them for their careers. See all their profiles, as well as more information on current and upcoming events on

<http://physics.wku.edu>

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Physics on the Hill

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GREETINGS FROM THE CHAIR

Dr. Keith Andrew

It is my pleasure to welcome you to the 2007-2008 school year with a number of outstanding accomplishments from our students and faculty. In the highlights enclosed, you will see that our students are actively engaged in research initiatives culminating in presentations at prestigious national conferences. The department's commitment to undergraduate participation in forefront research is clearly exemplified by these highlights, and certainly makes WKU one of the best places for an education in physics and astronomy.

Our faculty and staff continue to be leaders in the classroom, in research, in outreach and in service. There is no better place to see this than in the article describing the winner of the highly selective 2007 University Faculty Award for Public Service won by Dr. Richard Gelderman where he has been active for over a decade in making science come to life for so many students. A new, cutting-edge research facility has been added to the API in the area of Cyber Defense where we have joined forces a host of institutions to analyze the safety of computer systems. An international collaboration with South Africa spearheaded by Dr. Charles McGruder is another large scale collaboration that is underway with the Univ. of Capetown and the National Society of Black Physicists. When you have the opportunity, I invite you to visit our website <http://physics.wku.edu>. There you will find further description of the activities highlighted here, as well as our many other activities, including a description of the new Applied Physics track, and imaging of the recent naked-eye Comet 17P/Homes by our faculty and students.



RICHARD HACKNEY 1944 - 2007

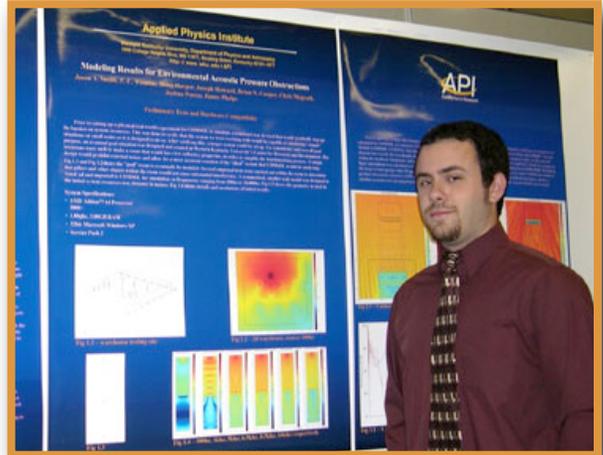
It is with a heavy heart that I announce the passing away of Dr. Richard Hackney, a long time leader and visionary of the Department of Physics and Astronomy. Dr. Hackney joined the department at WKU in 1972 after receiving his Ph.D. in Astronomy from University of Florida. He rose through the ranks and served as the Director of the NASA Kentucky Space Grant Consortium, Interim Department Head, the early director of Bell Observatory, Director of the NASA EPSCoR program, member of the NASA International Ultraviolet Explorer Final Archive Committee, was a member of the Executive Committee of the National Council of Space Grant Directors, on the Board of Directors of the National Space Grant Foundation and a member of Phi Beta Kappa. His enthusiasm, energy, camaraderie will be sorely missed and his many students and friends were fortunate to have spent time and learned from him and we send out deepest sympathies to his close family and friends. A PowerPoint review of his career and many contributions is available on the departmental web site,

http://physics.wku.edu/Richard_Hackney/

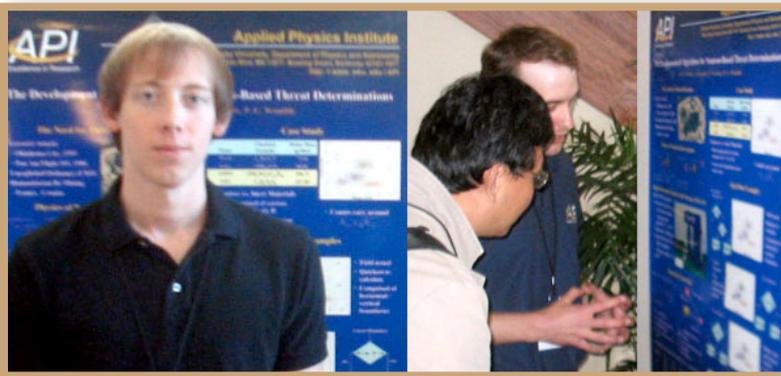
STUDENT HIGHLIGHTS

INTERNATIONAL COMSOL CONFERENCE

Jason Smith, an undergraduate student researcher from the Applied Physics Institute, traveled to Boston, Massachusetts for the Third Annual International COMSOL Conference (October 4 - 6, 2007). COMSOL, Inc. hosts this conference to showcase the uses of its MultiPhysics simulation software models in real physical laboratories. Smith, who works on a defense-related project, presented a benchmark test to analyze how accurately sound propagates through walls in the COMSOL acoustic module. His project entitled “Modeling Results for Environmental Acoustic Pressure Obstructions” was advised by Dr. Phil Womble. “I was able to do a lot of networking while I was there, and received valuable feedback about our project from everyone who attended,” said Mr. Smith.



APS DIVISION OF NUCLEAR PHYSICS MEETING



Two undergraduate student researchers, Matt Nichols and Robbie Phelps, traveled to Newport News, Virginia on October 10 - 13 for the Annual Meeting of the Division of Nuclear Physics of the American Physical Society. Nichols and Phelps presented posters of the work they have done at the Applied Physics Institute. Nichols's presentation described decision-making algorithms for neutron-based threat detection systems (Faculty advisors: Dr. Alexander Barzilov, Dr. Ivan Novikov). Phelps presented applications of gamma-ray spectroscopy using LabVIEW (Faculty advisor: Dr. Doug Harper). Nichols and Phelps were awarded grants from the very competitive National Science Foundation Conference Experience for Undergraduates Program. “This conference gave me an excellent opportunity to see the research that my colleagues are doing, and the research of professionals around the world who are trying to advance our energy standards and the overall knowledge of mankind,” said Matt Nichols.

ARGONNE NATIONAL LABORATORY

Eleven WKU physics students traveled to Chicago Nov. 2 - 3 for the 18th Annual Argonne National Laboratory's Undergraduate Symposium in Science, Engineering and Mathematics. The trip was co-sponsored by Department of Physics and Astronomy and the Society of Physics Students. WKU students presented their work alongside multi-disciplinary science undergraduates from all over the country. Students also toured the Argonne facilities, including Advanced Photon Source, the Tandem Linear Accelerator System (ATLAS), and nuclear power development facilities at Argonne National Laboratory. See <http://www.wku.edu/news/releases07/november/argonne.html> for more information.

KENTUCKY ACADEMY OF SCIENCE CONFERENCE

Two physics students traveled to the 93rd Kentucky Academy of Science meeting held at the University of Louisville on Nov. 8 - 10. Lisa Taylor presented a poster entitled "Simulating Large Scale Structure in the Universe Using a Massively Parallel Computer: Void Probabilities", and Jason Carson presented "Effective Cosmological Constant for an Extra Dimensional FRW Gauss-Bonnet Cosmology", which won best presentation in the physics category.

SUMMARY OF STUDENT AWARDS

Sarah McMurray has been awarded the Dr. George V. and Sadie Skiles Page Award for Excellence in Scholarship. Sarah graduated with a degree in Physics and Photojournalism, and received the Page award as the graduating physics major with the highest overall academic standing. Sarah has performed research with WKU Physics and Astronomy faculty in a variety of fields, including physics education, astrophysics, particle physics, and cosmology.

Jeremy Board has been awarded the Dr. Douglas Humphrey Award for Outstanding Service. He plans on working in industry for a while before heading to graduate school. In recent years, Jeremy has volunteered for almost every pressing duty in the Department of Physics and Astronomy, with special service devoted to the Society of Physics Students.

Ian Rice has been awarded the Dr. Randall Harper Award for Outstanding Research in Physics and Astronomy. Ian's research at WKU has been notably diverse; he has made significant contributions to projects with six different physics faculty members.

GRADUATES

Eric Haley (Spring '07), Jeremy Maune (Spring '07), Sarah McMurray (Spring '07), Jeremy Board (Spring '07), John Wimberly (Spring '07), and Earl Wood (Fall '06).

Further highlights of student activities are featured on:

<http://physics.wku.edu>

<http://www.wku.edu/API>

FACULTY HIGHLIGHTS

DR. HARPER NAMED MADOLE PROFESSOR OF PHYSICS

Dr. Doug Harper was recently named the Madole Family – Ogden Professor of Physics, a position established in memory of James Franklin “Jim” Madole and his sister Merle L. Madole.

Jim Madole graduated from WKU in 1935 as a physics major, and went on to earn a Masters in Physics and Electrical Engineering from the University of Illinois. Mr. Madole, until his retirement in 1980, worked for General Electric in various positions as Manager of Engineering Administration; Manager of Engineering; and Manager of Health, Safety and Environmental Protection. He served on several national committees, including 16 years as the GE Tube department’s representative on the JT-5 Receiving Tube Committee. He was the past Chairman of the ASTM Electrical Test Subcommittee and a senior member of the Institute of Electrical and Electronic Engineers. He served by appointment of four Kentucky Governors as a Board Member and Chairman of the KY Higher Education Assistance Authority. Merle, Jim’s younger sister, also a WKU graduate, journeyed to New York City and went to work for IBM shortly after the USA joined World War II. She worked for IBM for over thirty-five years, advancing through the corporation at a time when such positions were rarely held by women. Jim Madole’s wife, Georgetta Wilson Madole, said “Jim worked very hard to support himself through college, as did his sister Merle; and they would be very pleased to know that the scholarships associated with this professorship will help support students from Daviess and Ballard Counties who want to study physics.”



Requirements for this award include that the Professor maintains a record of outstanding leadership and productivity and show a special commitment to the recruitment of deserving students to major in physics from Daviess or Ballard Counties in Kentucky. The endowment associated with the Professorship will provide for a new Madole Scholarship to a WKU physics and astronomy student from Ballard or Daviess County. Finally, the Professorship will allow Dr. Harper to serve as an active member on the Ogden Research Scholars Committee, selecting students to receive scholarships that provide opportunities for the students to participate in scientific research projects. “I feel very honored to have been named as the Madole Family - Ogden Professor of physics. Having the Madole Family – Ogden Professorship within our department is just another example of the many positive initiatives going on right now that are leading to increased opportunities for WKU physics and astronomy students,” said Harper.

DR. GELDERMAN RECEIVES UNIVERSITY FACULTY AWARD FOR PUBLIC SERVICE



Dr. Richard Gelderman has been awarded the 2007 University Faculty Award for public service. Dr. Gelderman has initiated or contributed to countless programs which seek to involve the community in science, and to attract prospective science students to WKU. Since 1996 he has directed and hosted the public observing nights from the rooftop of TCCW. He also founded (in 1999) and continues to advise the Hilltopper Astronomy Club. Dr. Gelderman visits approximately 30 to 40 elementary, middle schools, and high schools per year. “I have a special passion for volunteering at elementary schools and working with the kids. They are so eager to learn and I know the help is much needed and appreciated there,” Dr. Gelderman said. By his actions, he has inspired his Hilltopper Astronomy Club students to also volunteer their time at local schools with him. He plans on continuing his volunteer work and giving back to the community for as long as possible. “Receiving this award is really on behalf of everyone in the physics department and Ogden College who also perform public service,” Dr. Gelderman said.

OUTREACH EFFORT TO PREPARE ASTRONOMERS IN AFRICA



Dr. Charles McGruder, the William McCormack Professor in Physics at WKU, is participating with the National Society of Black Physicists on a six-year, \$350,000 grant from the Kellogg Foundation to help South Africa increase its number of black astronomers. “As part of apartheid [prior to 1994], black South Africans were discouraged from getting higher degrees in important fields for economic development, specifically science and engineering,” Dr. McGruder said. “[black] South Africans today by and large don’t feel that science and engineering are for them.” The post-apartheid era South African government has decided to make major investments in the sciences including astronomy and astrophysics, which has led to the construction of the Southern African Large Telescope (SALT), the largest single optical telescope in the southern hemisphere, and other facilities. South Africa, however, lacks sufficiently trained astronomers to make use of these facilities, and would strongly benefit from black astronomers.

WELCOME DR. WILLIAM KOMP

This year we are fortunate to welcome aboard a new visiting faculty member, Dr. William Komp. Dr. Komp’s research area is in gravitational physics where he is especially interested in the very dynamic intersection between observational cosmology and Einstein’s general theory of relativity. Dr. Komp received his undergraduate degree at University of Louisville and his MS from University of Chicago. He then joined the nationally recognized relativity research group at University of Wisconsin, Milwaukee, where he completed his Ph.D. in cosmology. Prior to coming to WKU he was at University of Louisville and continues an active research program with collaborators at both institutions.

RESEARCH HIGHLIGHTS

API OPENS CYBER DEFENSE LABORATORY

The emergent threat of computer network attacks of critical infrastructure objects has elevated the demand for analysis of attack patterns and development of countermeasures. The Applied Physics Institute of WKU has collaborated with Mississippi State University, University of Arizona, EdAptive Computing, Inc. and Electronic Warfare Associates to create a new program called Network Attack Characterization Modeling and Simulation Testbed (NACMAST). The NACMAST contract originates from the Army Research Laboratory. The faculty and students involved at the Applied Physics Institute will be working on cyber defense issues from the U.S. Military. This is a multidisciplinary project that involves the departments of Computer Science and Mathematics in WKU's Ogden College of Science and Engineering.

Using the \$269,000 contract received from the Electronic Warfare Associates Government Systems, Inc., WKU has constructed a 1,200 square foot Cyber Defense Laboratory at the Innovation and Commercialization Center to house the new NACMAST project. The Cyber Defense Laboratory contains a quarantined "sandbox" where viruses that originate network attacks can be released and studied in hopes of achieving faster, effective detection and prevention of future attacks.



The project involves construction of a state-of-the-art computer network testbed designed for simulation of network attacks to test security software and procedures. The 24 networked PC computers are divided in three groups: "aggressors" for simulation different types of network attacks, "common users" to simulate normal network activity (such as downloading, uploading and trading information), and "monitoring group" to monitor activity in the different points of the network through the secure connection.

The testbed is used for development of algorithms utilizing wavelet-based methodology to detect attack patterns in the network traffic. The ability of each algorithm to detect anomalies in network information traffic will be tested against the approved attack (positive) signals and common network activity (negative) signals. The false positive and true positive rate will be calculated as a function of the internal parameters (threat thresholds) of the tested algorithm. By adjusting internal parameters of the network detection algorithm the optimal false positive and true positive rates can be achieved. In the future, NACMAST will serve as a certification entity for various computer intrusion remedies. "With the opening of the Cyber Defense Lab, a new era has embarked at WKU that provides unique opportunities in research and education, as well as helping our national defense efforts," said Dr. Phillip Womble.

SKYTEACH TAKES OFF

Western Kentucky University will receive a five-year grant of up to \$2.4 million for WKU's SKy Teach, a program to increase the region's math and science teachers through improved methods for introducing undergraduate math and science majors to secondary school teaching. The program will be led by Dr. Scott Bonham (principle investigator) and Dr. Richard Gelderman (co-director). Numerous faculty from Ogden, the College of Education and Behavioral Sciences, and the Potter College of Arts & Letters will participate as collaborators.



The grant is one of 10 national awards from the National Math and Science Initiative (NMSI) to implement programs modeled after UTeach, a highly successful math and science teacher preparation program at the University of Texas at Austin. The UTeach program was established in 1997 as a new and improved way to introduce undergraduate math and science majors to secondary school teaching. By offering compact degree plans, early teaching experiences and financial assistance for undergraduate students, UTeach provides a platform for raising the quantity and quality of mathematics and science teachers in secondary schools.

TELESCOPE NETWORK GOES GLOBAL

The Institute for Astrophysics and Space Sciences, thanks to the efforts of Dr. Sergey Marchenko, has added a telescope in the Ukraine to its growing telescope network. The telescope is a 1.3m telescope sited at the Crimean Astrophysical Observatory. The IASS has a memorandum of understanding with CRAO where IASS astronomers receive 30% of the time on the telescope for research projects. In return, the IASS provided a science camera, guiding system and supporting computer equipment. The data obtained from the telescope supports student and faculty research projects. The first year of the project has just finished, and IASS faculty and students have benefited greatly from this collaboration and are looking forward to a long and prosperous relationship with CRAO.

HIGH SCHOOL MENTORSHIP ACTIVITIES GO NATIONAL WITH CITEAM PROJECT

IASS faculty have become mentors and the Bell Observatory a telescope node in an NSF funded project known as Cyber Infrastructure Team, or CITeam for short. The project is organized by the University of Chicago, Northwestern University and the Adler Planetarium and Science museum. Through the Collaboratory (an easy-to-use, web-based collaborative environment that teachers use to develop project-based activities), high school students and teachers from across the country can take part in an online curriculum to understand the quasar phenomena. The students learn about quasars, use the Sloan Digital Sky Survey to identify candidate quasars, then verify their candidates by requesting observations through one of the two telescope nodes in the project, the Bell Observatory or the Perth Observatory (in Australia). IASS faculty serve as mentors to the high school students, checking in on their online journals and communicating with the students via tools within the Collaboratory. We also process and provide the data requested by the students. This effort is being led by Dr. David Barnaby, the Observatory Education Scientist.

WESTERN KENTUCKY PHYSICS OLYMPICS ('08)



Science of Wizardry is the theme for this year's Western Kentucky Physics Olympics, a half-day competition consisting of a pentathlon of challenging problem-solving activities that reward teamwork, creativity, and communication. The WKU Department of Physics and Astronomy is inviting each high school in the region to send one or more teams of four to compete in the 2008 Western Kentucky Physics Olympics. 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 23 from 8:30 a.m. until about 2:00 p.m. in the Thompson Center, Central Wing.

Each high school in the region is invited to send one or more teams of four students to compete in the Physics Olympics. This year's event will commence with the **Dematerialization** contest, requiring each team to perform for the judges a demonstration of making a pencil disappear, as well as to present a report that identifies the science behind their act of dematerialization. For the next event, **Electromagnetic Quidditch**, each team will design, construct and use an electromagnetic device to launch a ring-shaped iron "quaffle" through three scale-sized quidditch hoops. This year's Calculation/Communication Challenge, **Transfiguration**, requires two members of the team to carefully observe and devise a plan to transform a three dimensional shape into another shape, and the other two members to use those instructions to recreate the desired result. The final two events -- the "On-the-Spot Activity", a mostly hands-on, impromptu challenge, and the "Order-of-Magnitude Quiz", a brain teaser which asks contestants to quickly estimate answers for extreme situations -- will remain cloaked in secrecy until those events actually begin.

Teams can register online at <http://physics.wku.edu/olympics/registration.html>. The registration deadline is Tuesday, February 20.

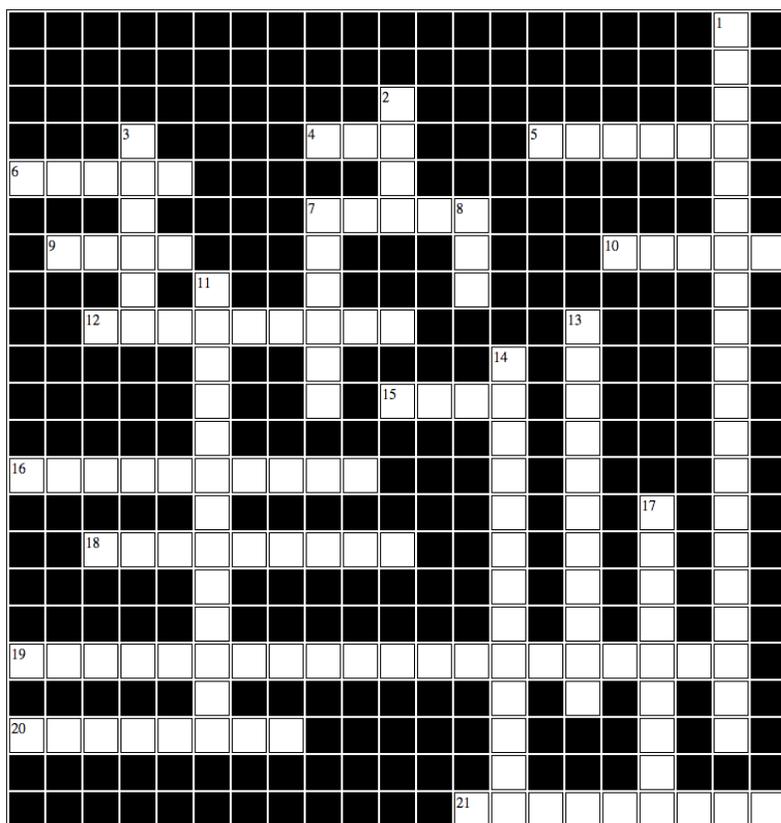
GIVING BACK TO THE DEPARTMENT

Alumni contributions to the Department of Physics and Astronomy will go a long way to ensuring that we have sufficient laboratory equipment and scholarship support for our students. Your help is needed more than ever as budgets remain extremely limited. Please consider making a contribution to the Department and to the University. Donations can be specified to be used for laboratory or instructional equipment use or for any one of our departmental scholarship funds listed

<http://physics.wku.edu/support.html>

Information on how to contribute is also available on the website or call (270) 745-4357

A WAVES CROSSWORD (Solutions are posted on <http://physics.wku.edu/strolger/crossword/>)



Across

4. A string vibrates with a frequency of 197 Hz. Assuming the speed of sound in the air is 394 m/s. The wavelength of the sound waves produced by the string is _____.
5. The time it takes to execute a complete cycle of motion is _____.
6. The perceived highness or lowness of a sound, depending on the frequency of the sound waves is _____.
7. Intensity of the sound waves produced by a trumpet is .0012 when the trumpet is at a distance of 2.5 m. What is the power output of the trumpet? Assume sound waves are spherical. Round to a whole number.
9. The interference of waves of slightly different frequencies traveling in the same direction, perceived as a variation in loudness is _____.
10. _____ of almost every kind require a material medium in which travel.

12. A condition that exists when the frequency of a force applied to a system matches the natural frequency of vibration of the system is _____.

15. A wave whose source vibrates with simple harmonic motion is called a _____ wave.

16. The distance between two adjacent similar points of the wave, such as from crest to crest or from trough to trough is _____.

18. Frequency and wavelength are _____ proportional.

19. Vibration about an equilibrium position in which a restoring force is proportional to the displacement from equilibrium is _____.

20. Measurements show that the restoring force is _____ proportional to the displacement of the mass.

21. The number of cycles or vibrations per unit of time is _____.

Down

1. Unless struck very hard a tuning fork only vibrates at its _____.
2. When the amplitude is halved, the energy decreases by a factor of _____.
3. The frequency of the thirteenth note is exactly twice that of the first note, and together the 13 notes constitute an _____.
7. Sound waves that the average human can hear, called audible sound waves have frequencies between _____ and 20,000 Hz.
8. The human _____ is divided into three sections.
11. A frequency shift that is the result of relative motion between the source of waves and an observer _____.
13. The region of a longitudinal wave in which the density and pressure are greater than normal is _____.
14. In a transverse wave, vibrations are _____ to the direction of wave motion.
17. The maximum displacement from equilibrium is _____.