

Physics on the Hill

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Department of Physics and Astronomy
Western Kentucky University
1 Big Red Way
Bowling Green, KY 42101

Stopping Terrorists

How the Applied Physics Institute is developing technologies for the War on Terror

WKU's Applied Physics Institute is developing technologies to help the Nation's war on terror. These technologies will help law enforcement officers or soldiers to detect explosives or other contraband materials such as drugs in a non-destructive and non-intrusive manner.

In the past, x-ray systems have been used to detect explosives. Operators of these systems look for suspicious shapes and wires. However, terrorists have become sophisticated in their methods of hiding explosives. Explosives can be differentiated from innocuous materials and from other contraband materials

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New Old Telescope

Exciting research projects are being initiated at the Bell Observatory

One of the best kept secrets on The Hill is WKU's 0.6m (24") telescope. Having recently been refurbished, thanks to a grant from NASA, the telescope is now embarking on a new era of scientific investigation and discovery.

The Bell Observatory, located on a hilltop 12 miles southwest of Bowling Green, has been operating since 1988, to support astronomy classes and for hands-on student training activities. Advances in telescope control systems and computing equipment now allow WKU's telescope to be operated in a fashion similar to telescopes at international observatories.

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Physics Scholars Have Outstanding Year

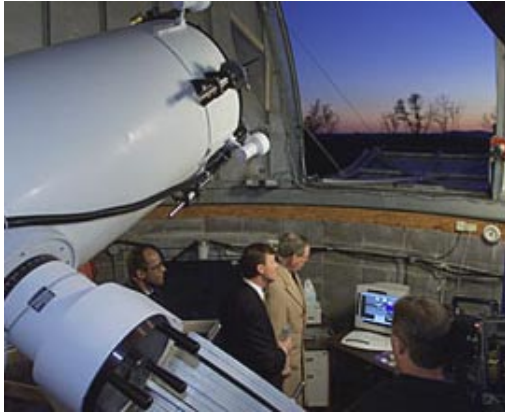
Students in the WKU Department of Physics and Astronomy racked up an impressive list of accomplishments from scholarly activities during the 2000-01 academic year.



Several students presented the results of their research activities at conferences. While the entire list is too numerous to mention, the conferences included: Argonne National Laboratory Undergraduate Research Symposium in Science, Engineering and Mathematics, Kentucky Academy of Science, National Conference on Undergraduate Research, NASA Undergraduate Research Centers Technical Conference, and WKU Sigma Xi Undergraduate Student Research Conference. Kenneth Purcell received an award for outstanding paper at the WKU Sigma Xi conference and Robert Taylor was awarded the outstanding paper at Kentucky Academy of Science.

Nine WKU physics majors obtained research fellowships for the 2001 summer term. Eight of the fellowships were sponsored by the National Science Foundation's Research Experiences for Undergraduates program, awarded on a competitive basis to students from throughout the country. Students from the Department who received NSF-REU

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At the dedication of the refurbished observatory, Dr. McGruder, University President Dr. Gary Ransdall and US Senator Mitch McConnell.

Old Galaxies...

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Bell Observatory is part of a larger project known as STARBASE: Students Training for Analytical Space Sciences Experiences. STARBASE will network telescopes sited around the world with students and faculty across the country and with high school students and teachers from Kentucky, the surrounding region and across the nation. WKU's 0.6m telescope is the first node in this network of robotic observatories. The telescope can be operated manually, with observers in the dome, or remotely from a control room in TCCW. Four of our Physics majors (Whitney Wills, Ashley Atkerson, Tala Monroe and Wes Ryle) are operating the telescope during the week.

The telescope is currently making observations designed to support two research projects. The first of these is a search for extra-solar planets, lead by Dr. Charles McGruder. Under this program we are looking for brightness changes in stars which indicate that the planet has passed between us and the star.

Our second program is also looking for brightness variations, though not in stars. Led by Dr. Michael Carini, this project is looking for changes in brightness in a class of quasar called BL Lacertae objects. The objects are the cores of galaxies which are emitting jets of material moving towards us at speeds nearly the speed of light. Because the objects are at great distances from us, they are also some of the oldest objects in the universe. By studying their brightness variations, we hope to learn more about the process operating inside the jets.

Michael T Carini

Students ...

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summer fellowships and their host schools are:

- Angela Adams, an Elizabethtown junior, University of Rhode Island
- Gavi Begtrup, a Nashville senior, University of Houston
- Michael Farinelli, an Oldtown senior, University of Florida
- Lindsay Hopper, a senior from Lafayette, Tenn., Ohio State University
- Srdan Hrkalovic, a Bowling Green junior, University of Louisville
- Scott Little, a Pikeville junior, University of Louisville
- Kenneth Purcell, a Henderson junior, Florida State University
- Wes Ryle, a Burlington sophomore, Vanderbilt Univ.

Joshua James, a Bowling Green sophomore, received a summer fellowship sponsored by the American Association of Physics in Medicine. He worked in the Department of Physics and the Medical School at Vanderbilt University.

Also, Adams, Hopper, Purcell, and Ryle along with Ashley Atkerson, Rob Taylor, and Tala Monroe, received scholarships from the Kentucky Space Grant Consortium for research activities during 2001-02. In addition, Adams, Begtrup, and Purcell recently received a \$2,000 research grant from the Sigma Pi Sigma Undergraduate Research Program. The grant will be used to purchase equipment for an "Investigation of Transport Properties of High-Tc Superconducting Materials" in the WKU Solid State Physics Laboratory.

Doug Harper



Dr. Scott Bonham (center standing) is a new member of the Physics Faculty. Turn to page 3 for a short profile.

Stopping Terrorists....

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through the examination of the elemental content. In particular, the ratios of chemical elements have been used to perform this differentiation with great success.

Pulsed Elemental Analysis with Neutrons (PELAN) is a system that determines the elemental content of objects in an automatic manner and was designed for the characterization of explosives. The system consists of a pulsing d-T neutron generator and a bismuth germanate (BGO) gamma-ray detector. PELAN is a small man-portable device, composed of a suitcase that contains the necessary power supplies for the neutron generator and the data acquisition system, and of a probe which is placed next to the object under interrogation (see figure below). The probe contains the neutron generator tube (upper horizontal tube in the figure), the BGO γ -ray detector (lower horizontal tube), and the necessary material to shield the detector from the neutrons (vertical tube). The total mass of the probe and suitcase is less than 45 kg.

In principle, a neutron impinging on an



object can initiate one of several nuclear reactions with the chemical elements of which the object is composed. In most of these cases, as a result of these reactions, γ rays are emitted with characteristic and distinct energies. These γ rays are like the "fingerprints" of the elements contained in the object. By counting the number of γ rays emitted with a

specific energy (e.g. the γ rays of sulfur), one can deduce the amount of the element contained within the object. In the case of an object that is hidden among other innocuous materials, the identification takes place through the correlation of various chemical elements observed, coupled to the information about the innocuous material itself.

The PELAN was invented by Dr. George Vourvopoulos, Director of the Applied Physics Institute. The two people chiefly responsible for its development are WKU Alumni, Dr. Phil Womble and Jon Paschal. As undergraduates Paschal and Womble worked closely with Vourvopoulos on applied nuclear research.

PELAN has undergone three field trials since 1999. The first field trial concentrated on PELAN's ability to detect explosives. PELAN was able to identify threats with 100% success. The other two field trials concentrated on detecting chemical warfare (CW) agents such as mustard gas, lewisite, and nerve agents such as sarin (sarin was used in the Tokyo subway attack several years ago).

The first CW agent trial took place in May 2001 at Poellkapelle, Belgium at

the request of the Belgian military. PELAN examined French, German, and British shells from World War I. Despite nearly a century beneath the soil, these weapons still posed a threat to the people of Belgium.

In the Belgium tests, PELAN was not only able to identify whether CW agent was present but also to identify the type of CW agent.



Jon Paschal (center with glasses), WKU alumnus and engineer at the Applied Physics Institute sets up the PELAN in Belgium. The clothing that he is wearing is chemical retardant.

Further tests of PELAN are planned for PELAN in 2002. And commercial prototypes of the PELAN are expected to be distributed to bomb squads in early 2002.

Phillip C. Womble

Dr. Scott Bonham Begins New Program in Physics Education

The WKU Department of Physics and Astronomy welcomed its newest full-time faculty member Dr. Scott Bonham (see picture page 2) at the start of the Fall 2001 semester. Dr. Bonham came to WKU from North Carolina State University where he was a Postdoctoral Fellow in the Physics Education R&D Group. His interests focus on the use of computers and the World Wide web for teaching Physics. He earned his Ph.D. in Physics from the University of Illinois at Urbana-Champaign and his B.S. in Physics from Case Western Reserve University.

He will be beginning a new research program in Physics Education Research at WKU. His website is physics.wku.edu/~bonham.

Want to Know More?

Tours of the Department, the Applied Physics Institute, or the Bell Observatory can be arranged.

For the Applied Physics Institute, contact either Dr. George Vourvopoulos or Dr. Phil Womble at 270 781 3859 or email: vour@wku.edu.

For the Bell Observatory, contact either Dr. Mike Carini or Dr. Richard Gelderman at 270 745 4357 or email: Mike.Carini@wku.edu.

Dr. Gelderman handles tours of the Department and can be reached at Richard.Gelderman@wku.edu.

We can also arrange speakers (faculty or students) to talk to your class. Call 270 745 4357 or email: womble@wku.edu.



Doug Jenkins of Warren Central High School sharing a demonstration at the Physics Teachers Alliance in Spring 2001.

Physics Teachers Alliance Meeting in Planning Stage

But we cannot do it without your support!

Due to scheduling conflicts with KSTA and low response, the Fall 2001 Physics

Teachers Alliance meeting was cancelled.

Physics Teachers Alliance is a group that meets once a semester to discuss teaching techniques, issues for teachers and general discussion. There are no membership fees or dues. The WKU Department of Physics and Astronomy provides only space, food, and logistical support. It is a meeting for teachers by teachers.

We want to schedule another meeting in Spring 2002 but we need to avoid the scheduling problems that happened this fall. Also, we want to show off some of our facilities such as the newly renovated Bell Observatory and the Applied Physics Institute

So what can you do?

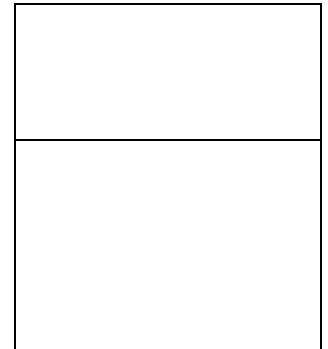
Call us at 270 745 4357 or email Dr. Phil Womble at womble@wku.edu if you are interested in attending.

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