

# Physics on the Hill

2006 - 2007, Volume 5, Issue 1



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### UPCOMING EVENTS

**Kentucky FIRST Lego League Tournament**

January 27, 2007

**Western Kentucky Physics Olympics**

*Pirates of the Bluegrass*

February 24, 2007

Registration Deadline, February 20, 2007

**Kentucky State Science Olympiad Competition**

April, 16 2007

### ALUMNI PROFILES AND MORE...

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

<http://physics.wku.edu>

# GREETINGS FROM THE CHAIR



Welcome and greetings as the 2006-2007 year begins, this is the year marking the 100<sup>th</sup> anniversary of the founding of WKU. Students and faculty are engaged in learning about physics, science and the world around us. Our students continue to make outstanding contributions to the department and university and have had a chance to visit a number of

leading science centers. Students presented findings at meetings such as the research symposium at Argonne National Laboratory and at a special presentation as part of the Posters at the Capitol, at the WKU Sigma Xi research conference, at the National Conference on Undergraduate Research, at the National Sigma Xi research conference, at the American Astronomical Society meeting, the American Physical Society meeting, the American Biophysics Meeting, Annual Conference of the National Society of Black Physicists, and National Society of Hispanic Physicists, Annual Meeting of American Biophysical Society, and the International Symposium on Technology and the Mine Problem. We are proud of the accomplishments of our students and faculty and look forward to hearing from them as the march ahead in their studies and careers.



This year we are very fortunate to have

added a new faculty member, **Dr. Ivan Novikov**. Many remember Dr. Ivan Novikov from when he served as a Research Associate at here in 2001-2002. We now have the pleasure of welcoming back Dr. Novikov as our newest Assistant Professor. Dr. Novikov received his undergraduate and graduate degrees in Physics from the St. Petersburg State University in Russia, and is most recently a former Post-Doctoral Research Associate from Purdue University, where he specialized in applied nuclear physics. He now eagerly shares his expertise in applied nuclear research with undergraduate students in the classrooms and at the API. Dr. Novikov is chiefly involved in several key investigations at the API, along with colleagues Dr. Phillip Womble and Dr. Alexander Barzilov. At the same time, Dr. Novikov

## SUMMARY OF STUDENT AWARDS

**Eric Houchens**, first place in Physics and Astronomy section at the 2006 WKU Sigma Xi Conference.

**Timothy Morgan**, Recipient of the 2005 George V. Page Award for Excellence in Physics Scholarship.

**Charles Poteet**, Recipient of the 2005 Douglas Humphrey Award for Outstanding Service in Physics; Best undergraduate presentation during Fall student colloquia series, 2005.

**Richard Walters**, Recipient of the 2005 Randall Harper Award for Outstanding Research in Physics.



*Highlights of student activities are featured on:*

<http://physics.wku.edu>

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

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has been keenly developing his many other research interests. He is embarking on projects which cover a broad, yet related range of physical fields, from medical nuclear physics to electronics development, and is also involved in a collaboration with the University of California Santa Cruz to develop a new facility for high energy physics.

We also have a chance to welcome aboard a new visiting faculty member **Dr. Michael McPherson**. Dr. McPherson's area of expertise is in acoustical physics. McPherson received his undergraduate degree in Physics from Rhodes College in Memphis, TN. His graduate work was conducted at the University of Mississippi, specializing in acoustical phenomena with the ultrasonics research group at the National Center for Physical Acoustics. Dr. McPherson most recently joins us as a former postdoctoral fellow at the National Center for Physical Acoustics in Oxford, MS. With a background in waves, optics and acoustics he will be teaching our optics course along with biophysics.



## STUDENT HIGHLIGHTS

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### API STUDENTS HELP US NAVY IN CLEAN-UP PROJECT

The Applied Physics Institute is giving students real-world experience across the country. API student researchers participated in the remediation of a storage facility located at the Indian Head Naval Facility in Indian Head, MD this past August. Research assistants Jeremy Board, Christopher Davenport, Christopher McGrath, Kyle Moss, and Matthew Nichols conducted research throughout the week long project.



API students worked directly with a PELAN III system, which performs elemental analysis on different types of objects. WKU Associate Professor Dr. Phillip Womble and API Senior Applications Engineer Jon Paschal led students throughout the recovery of 243 items. The PELAN III examined all of the items and their elemental contents. Students gained valuable knowledge and research skills throughout the week. Chris McGrath said that he appreciated the project in because he could apply his classroom knowledge to a real situation and feels that the experience will benefit his future in many ways.

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# FACULTY HIGHLIGHTS

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## DARK ENERGY AND THE “NATURE” OF COSMIC EXPLOSIONS

*Dr. Louis-Gregory Strolger*

This year I have had the fortune of being involved in two exciting announcements in hot topics of astronomy, dark energy and gamma-ray bursts.



Almost decade ago, a rather astonishing discovery was made. As we are well past the Big Bang that set the early cosmos in motion, an expectation was that for most of the cosmic history, the universe has been slowly decelerating in its own self-gravity of the stuff within it. Two competing teams of astronomers set out to measure that rate of deceleration, but surprisingly concluded that the universe is not decelerating. Contrarily, it **accelerating in its expansion**, essentially pulling itself apart! The discovery resurrected general relativity’s “cosmological constant”, a mathematically feasible concept originally invoked with almost no physical rationale (a rarity for Einstein). Spending decades in obscurity, it has now been resurrected with a new more general name, “dark energy”, and is the leading explanation of our accelerating universe. However we still lack a solid physical explanation of what it is (there are literally thousands of equally poor explanations).

Nearly a decade after the dark energy discovery, we are finally making progress in tracing a more

complete description of its nature, i.e. its current strength and its possible evolution with time. Using the Hubble Space Telescope, myself along with colleagues including Dr. Adam G. Riess of Johns Hopkins University and Mario Livio of Space Telescope Science Institute, have spent the last five years narrowing the field of possibilities on dark energy. In our recent NASA press release<sup>1</sup>, we announced that dark energy appears to behave 9 billion years ago much as it does now, a strong indication that dark energy is indeed a “cosmological constant”, a property of space-time itself whose strength grows only with the size of space itself. We are indeed zeroing in on the properties of dark energy. Hopefully, theory will make similar strides in predicting the observed nature.

In recent years, great strides have also been made in the understanding the long standing mystery of gamma-ray bursters (GRBs). We now understand that there is a connection between these events and core-collapse supernovae, and may in fact may be signaling the formation of distant stellar black holes. Just how similar GRBs are to supernovae has remained an outstanding question. Myself and colleagues including Andrew Fruchter of the Space Telescope Science Institute announced in Nature<sup>2</sup> this year that long GRBs and supernovae are statistically not found in the same galactic environments. The GRBs are far more concentrated in the very brightest regions of their host galaxies than are supernovae. The galaxies with GRBs are also fainter and more irregular than those where supernovae are seen. This evidence suggests that only the very most massive stars produce long GRBs, and that they are restricted to locations where the abundances of elements heavier than helium are much lower than in the Milky Way.

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<sup>1</sup> NASA release archive, 06-353, 11-16-2006, “NASA’s Hubble Finds Evidence for Dark Energy in the Young Universe” [http://www.nasa.gov/home/hqnews/2006/nov/HQ\\_06353\\_Hubble\\_Dark\\_Energy.html](http://www.nasa.gov/home/hqnews/2006/nov/HQ_06353_Hubble_Dark_Energy.html)

<sup>2</sup> *Nature* **441**, 463 - 468 (25 May 2006) Article, <http://www.nature.com>

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## TO BE, OR NOT TO BE... NO LONGER A QUESTION FOR PLUTO

This year, the International Astronomical Union (IAU) stripped Pluto of its planetary status after a “long and lively debate.”



**Dr. Richard Gelderman**, was among more than 2,000 astronomers who debated the issue during the IAU’s 26th General Assembly in Prague, Czech Republic this August. “People were passionate on both sides of the issue,” said Gelderman. “It’s not that we don’t like Pluto. It just doesn’t fit the new criteria.”

“Pluto has always been the odd man out,” he said. “I’ve always taught that there are four Earth-like rocky planets and four Jupiter-like gaseous planets and then there’s Pluto.” The IAU, the world’s largest professional group for astronomers, conformed the basic tests that celestial objects will have to meet before they can be considered planets and join Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. Pluto will be reclassified in a category called “dwarf planets.” A third class of objects that orbit the sun, such as asteroids, comets and other natural satellites, will be called “small solar system bodies.”

“Pluto and other objects are not like the eight planets we’re familiar with so this gives them a new category,” he said. “For me, Pluto will just have a different name as a dwarf planet.”

The debate over Pluto has been a long lingering issue in the astronomical community that was rekindled by the discovery in 2003 of UB313 (or **Eris**, as it is more commonly called), a large icy body in orbit around the Sun well beyond the orbit of Pluto.



The recent debate has been whether this new object should be classified as a planet, and if not, why Pluto, smaller than the new object, should still be classified as a planet. When Pluto was discovered in 1930, nothing else like it had been discovered so it was easy to add it to the list of planets. “But now we believe there may be more than a dozen objects with the size and composition of Pluto,” Gelderman pointed out. Although the decision provides a clearer definition of “planet-hood”, there is still likely to be debate ahead as more large objects are discovered beyond the orbit of Pluto, and when planets orbiting other stars are finally imaged.

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## DARK SUSY

Dr. Bret Bolen writes, “While teaching at WKU has taken most of my time, I have been able to conduct a modest amount of research in general relativity and cosmology. One project which I worked with Drs. Andrew Banarby, and Strolger in advising Sarah McMurray in running a numerical simulation of neutralinos using the Dark SUSY software package. Neutralinos are very good candidates for dark matter if one believes in an extension of the standard model known as supersymmetry (SUSY). Sarah has found a range of parameters in Dark SUSY which produce neutralinos of the appropriate mass to be sources of dark matter which have not been ruled out by collider experiments at Fermilab.”

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### **Interesting Physics Fact:**

*In 1903, Albert Michelson, one of the 19<sup>th</sup> century's top physicists, commented "The more important fundamental laws and facts of physical science have all been discovered, and these are so firmly established that the possibility of their ever being supplemented in consequence of new discoveries is exceedingly remote". Two years later, Einstein published his revolutionary Theory of Special Relativity.*

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### THE 2007 WESTERN KENTUCKY PHYSICS OLYMPICS *Saturday, February 24th*

**Pirates of the Bluegrass** 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 & Astronomy invites each high school to send one or more teams of four to compete in the 2007 Western Kentucky Physics Olympics. This year's event will be held Saturday, February 24 from 8:30 a.m. until about 2:00 p.m. in the Thompson Center, Central Wing on WKU's Bowling Green campus.

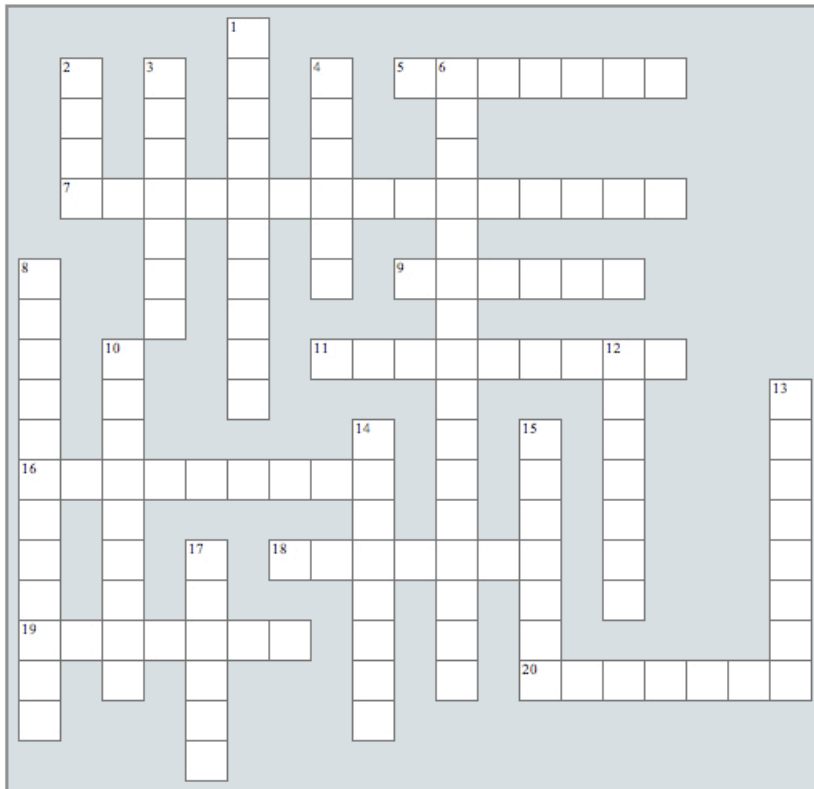
The competition will commence with two activities that involve competitors arriving at the event ready to compete with devices they have designed, constructed, and tested. The competition entitled **Sail Ho! – Spyglass to the Horizon** requires each team to design, construct, and use a telescope to resolve a distant image. **For Bungee From the Crows Nest** each team will acquire and test an elastic cord to be able to drop a particular mass from a given height so that it drops as close as possible to the deck of the ship without actually impacting. This year's Calculation/Communication Challenge will be a test of pulleys and levers to lift a treasure chest out of its hole, requiring two members of the team to make a series of measurements and the other two members to follow the devised plan and actually lift the chest. 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.

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.

For additional information visit <http://physics.wku.edu/olympics>

# A NUCLEAR PHYSICS CROSSWORD



## Across:

5. A form of hydrogen that is radioactive, used in nuclear weapons and is currently used to create luminescent dials for watches.
7. The location of the most serious accident in commercial nuclear power generation history in the United States. There have been no known injuries or deaths as a result of the accident and few if any cancer deaths are expected as a result. (Three words)
9. This radioactive element was once used to create luminescent dials for watches.
11. This element is not found naturally and is used in nuclear weapons as well as some nuclear power plants.
16. The location of the worst accident in nuclear power generation history (in any country). The IAEA has attributed fifty-six deaths to this accident though the long-term numbers of deaths is expected to be in the thousands.
18. Dense center of an atom for which Nuclear Physics are named.

19. An atom having the same atomic number but a different atomic mass.

20. Sub-atomic particle with a neutral charge.

## Down:

1. Female Polish scientist famous for her pioneering work with radiation. Her death from aplastic anemia is thought to be the result of her research.
2. \_\_\_\_ reactors do not require a moderator and are able to consume a wider variety of nuclear fuel.
3. Most nuclear reactors are \_\_\_\_\_ reactors which require the use of a moderator.
4. Process by which two atoms merge into one. This process powers the Sun and increases the power of modern nuclear weapons.
6. Process by which unstable atoms emit radiation. (Two words)
8. Although the United States and many other countries do not currently recycle nuclear fuel it is possible to eliminate most nuclear waste by \_\_\_\_\_ the spent fuel.
10. Substance that slows neutrons in order to maintain a nuclear reaction (used in most nuclear reactors).
12. This naturally occurring element is used in nuclear weapons as well as in most nuclear power plants.
13. A loss of control of a nuclear reactor can result in a \_\_\_\_\_ in which all or part of the reactor core melts.
14. Sub-atomic particle with a negative charge.
15. Process by which an atom splits into two or more parts. This process was used in the first nuclear weapons and in all current nuclear power plants.
17. Sub-atomic particle with a positive charge.

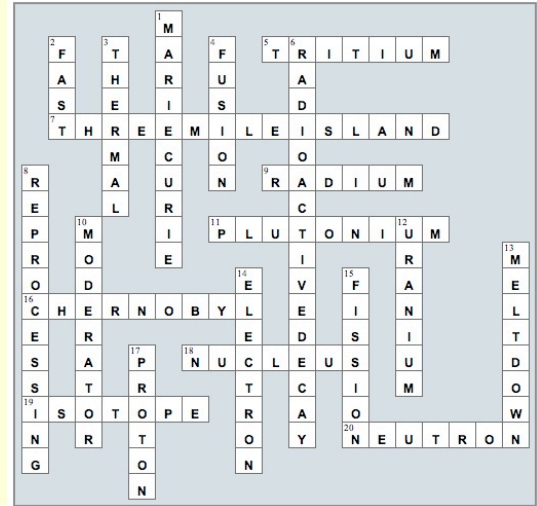
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# GIVING BACK TO THE DEPARTMENT

Alumni contributions to the Department of Physics and Astronomy will go a long way to ensuring that we have sufficient supplies and equipment for student use. Your help is needed more than ever as budgets remain extremely limited. When you receive a call from our students, or whenever the spirit moves you, make a contribution to the Department and to the University. Be sure to specify that the money be designated for use by the Department of Physics and Astronomy. Our profound thanks to our contributing alumni. For information on how to contribute please contact:

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**Crossword puzzle solution.**



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ADDRESS CORRECTION REQUESTED

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