This year has seen an expansion of the department with the addition of Dr. Brian C. Sell. He is an Ohio native and a Mount Union alumnus who went off to the University of California at Davis to get a Ph.D. in Physics. While there, he also gained global teaching experience and participated in extensive research.

He spent several years at Lawrence Berkeley National Laboratory using synchrotron radiation from the Advanced Light Source to study materials made of magnetic layers on the order of a nanometer thin. A novel technique of making an x-ray standing wave through the material allowed for the characterization of the interactions of different metallic layers. The results of these studies will ultimately help make smaller and more efficient computing components.

Brian is currently enjoying living in uptown Westerville with his wife, Stephenie, the lovable dog Patches, two cats, and is expecting another warm body in the house in April.

One of the most interesting problems in astrophysics today is the origin of cosmic rays with extremely high energies above \(10^{19}\) eV (electron volts), about a million times more than the highest energies we can produce in any terrestrial particle accelerator. Ultra-high energy cosmic rays pose two main questions. First, what mechanism(s) could accelerate particles to such high energies? Second, how do they maintain their energies as they propagate across the vast distances of space?

The first question is puzzling since it is unknown which physical mechanisms can result in ultra-high energy cosmic rays (\(10^{19}-10^{20}\) eV) (Supernova explosions can produce particles with energies up to about \(10^{15}\) eV). While more speculative and exotic possibilities have been considered, the primary suspects are Active Galactic Nuclei (AGNs), which are extremely energetic galactic cores thought to be driven by super-massive black holes.

As for the second question, there is an effective upper limit on how far cosmic rays can travel before they lose energy. Above energies of \(6 \times 10^{19}\) eV cosmic rays interact strongly with photons from the cosmic microwave background, which leads to rapid losses of energy through the production of subatomic particles called pions. Ultra-high energy cos-
Physics Coffee Hour
Each week the Physics Dept. gathers to promote physics knowledge at OC through informal discussions and presentations from guest speakers.

Join us Mondays 3:00 p.m. in Room 244, Science Bldg.

Observing at the Metro Parks
Escape the city lights to view the night sky at Prairie Oaks Metro Park. This is a public and free event, and anyone interested is welcome.

Take I-70W. Shortly after exiting Franklin County, take the Route 142 exit (W Jefferson/Plainville) and turn right. After about a mile you will see Prairie Oaks on your right.

In the News
Science Building Renovation Underway
Work began in June 2007 on the $20M science building project, involving a complete renovation of the existing facility and the addition of 30,000 square feet of classrooms and laboratories. The addition will extend south towards the Battelle Fine Arts Center. The result will be a state-of-the-art science facility with technologically advanced classrooms and enhanced and expanded lab spaces for teaching and research.

At present, the eastern end of the building is being renovated. This work will be complete in December 2007, at which point the Physics and Chemistry departments will vacate the western end of the building and move to temporary quarters. We hope to accomplish the move and be ready to teach again at the start of winter quarter. The second phase is the bigger part of the project and will be complete in the spring of 2009.

http://www.otterbein.edu/giving/science_bldg.asp

OSAPS Meetings for 2007-08
Two meetings of the Ohio-Region Section of the American Physical Society (OSAPS) are scheduled for this academic year.

The autumn conference at Miami University takes place October 19 & 20, 2007 and focuses on undergraduate research. There will be an evening performance about the life of eminent franco-polish physicist and chemist Marie Curie, played by artist Susan Frontczak.

The spring conference will be at Youngstown State University on March 28 & 29, 2008. The main theme is "Touring the Electromagnetic Spectrum".

The meeting is a joint venture of OSAPS and the Ohio and Western Pennsylvania sections of the American Association of Physics Teachers. Both conferences will be Friday afternoon/Saturday morning events, and are free for students. Although there is a set of plenary talks on the main theme of the meeting, many more short talks with topics from all areas of physics are scheduled in the parallel sessions.

The OSAPS conferences are a wonderful and non-threatening opportunity for undergraduates to get their feet wet and visit a first professional conference!

Physics Challenge
The circuit shown extends to the right to infinity. Each battery has emf, $E$, and internal resistance, $r$, and the resistors all have resistance, $4r$. The ideal ammeter reads a current, $I$. Find the value of $E$ in terms of $I$ and $r$.

Solutions to Challenge problems at http://www.otterbein.edu/physics
Observing the Planets

This academic year we have the possibility to see all five outer planets in prime observing position. This is not always the case, since Mars is fast enough to give Earth a race around the sun such that we catch up with the red planet only every other year.

Prime planetary observing opportunities occur when a planet, the Earth, and the Sun are situated in a straight line, so the planet is exactly opposite from the Sun, a configuration called opposition by astronomers. In this position the planet reaches its highest point in the southern sky exactly at midnight, and is also typically closest to Earth, which means it appears as bright and big as possible.

Mars will be in opposition on December 24, but, due to its eccentric orbit, will have reached its closest position to Earth on December 18, when its apparent diameter will be 15.9 seconds of arc. Even though the giant gas planet Jupiter (see photo) takes almost 12 Earth years to orbit the Sun, it reaches opposition every 13 months (this year on July 9, 2008), because of Earth’s much shorter orbit. Even further away is the ringed planet Saturn, in opposition on February 24. The rings appear thin since Saturn is displaying them almost edge-on this year. While Jupiter and Saturn appear to the naked eye as bright stars, the other two gas planets Uranus and Neptune, which are even farther away, are best seen with binoculars or a telescope. Uranus appears as a greenish disk and is in opposition September 13, 2008, whereas Neptune, an even smaller, slightly deeper green disk, reaches its prime spot on August 15, 2008.

Auger Observatory (cont.)

Cosmic rays made of protons travel not more than 500 million light years (Mly). Any of these cosmic rays we receive here at Earth could not have come from very far away, cosmologically speaking.

When cosmic rays reach Earth’s atmosphere, they collide with nuclei in the upper atmosphere, producing showers of particles that can reach the Earth’s surface. These particle showers can be detected and their paths reconstructed to determine the trajectory of the originating cosmic ray. The original trajectories can be extrapolated backwards to try to identify the source(s) of these exotic particles.

The Pierre Auger Observatory was built to detect the particle showers caused by cosmic rays. The observatory is located in Argentina and consists of 1,600 water-Cerenkov detectors spread over about 3,000 square kilometers. A particle shower from a single cosmic ray triggers several detectors. The energy of the cosmic ray is determined from the number of particles in the shower (events) and its trajectory is determined by the precise timing of these events. (During a trip to Fermilab in spring of 2003, the Otterbein Society of Physics Students toured the development facility for these detectors.)

During the course of about two years, the observatory detected 27 ultra-high energy cosmic rays. Initial results suggest that these rays do indeed come from nearby AGNs located within 300 Mly from Earth. While more data is needed to pinpoint their sources more precisely, it is already clear that they arrive from specific directions and not isotropically (all directions with equal likelihood).

As more data is taken, it is hoped that a clear picture of the sources of these mysterious particles will emerge. It is hoped that the observatory will eventually be able to measure the energy spectra of the rays from individual sources, shedding new light on the mechanisms behind their production.

Additional Sources:
http://www.auger.org

“Starry Mondays” Continue at Otterbein

Join Dr. Uwe Trittmann for “Starry Mondays,” held the first Monday of each month during academic terms. Lectures & observing (weather permitting) are free and open to everyone!

Topics so far this year have included Recent Advances in Astronomy and The Birth of Modern Astronomy. Your suggestions for future topics are welcome!

Join us at 7 p.m., in room 238 in the Science Building. See dates on back.

Happy Observing!

Planets in Opposition

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<tr>
<th>Planet</th>
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<tbody>
<tr>
<td>Mars</td>
<td>Dec. 24, 2007</td>
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<tr>
<td>Jupiter</td>
<td>Jul. 9, 2008</td>
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<tr>
<td>Saturn</td>
<td>Feb. 24, 2008</td>
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<tr>
<td>Uranus</td>
<td>Sep. 13, 2008</td>
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<tr>
<td>Neptune</td>
<td>Aug. 15, 2008</td>
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“Starry Mondays”
Astronomy Lecture Series
Mondays
Oct. 1, 2007, 7 p.m.
Nov. 5, 2007, 7 p.m.
Feb. 4, 2008, 7 p.m.
Mar. 3, 2008, 7 p.m.
Apr. 7, 2008, 8 p.m.
May 5, 2008, 8 p.m.
Jun. 2, 2008, 8 p.m.

Night Sky Observing
Prairie Oaks Metro Park
Fridays
July 20, 2007, 9 p.m.
Oct 19, 2007, 7 p.m.
Nov 16, 2007, 6:30 p.m.
Jan 11, 2008, 6 p.m.
Feb 15, 2008, 6:30 p.m.
May 9, 2008, 9 p.m.

Coffee Hour
Mondays, 3:00 p.m., Science Bldg. Room 244

Society of Physics Students
Dates TBA