Seeing Stars with a Whole New Light

One of the local impacts of Prof. Jim Madsen’s increased role in the Wisconsin IceCube Particle Astrophysics Center (WIPAC) is a whole new way to see the stars. This April, the UWRF Planetarium received the delivery of a new digital projection system that will enhance regular planetarium shows as well as allow additional uses of the planetarium space.

The new projector replaces the original Spitz projection system that was installed in 1966. While still functional, the Spitz projector is more difficult to maintain and can only be used to project the stars and planets. The projected stars pattern is also quite dim (more like the real night sky), which requires the audience to dark-adapt their eyes before the presentation can begin.

The new projector is basically a regular digital projector outfitted with a special ‘fisheye’ lens in order to display images onto the spherical surface of the planetarium dome. The two main advantages of this system are the increased brightness of the images, which will allow planetarium shows to begin as soon as people are seated and the doors are closed, and the ability to project any image onto the dome. This flexibility will allow the dome to be used by a variety of disciplines where being able to display complicated information in a visually immersive environment can help convey the information more effectively.

The projector is only part of the story, however. The other important aspect of the new system is the software that is used to generate the Planetarium shows. The images shown on screen are based on real astrophysical data: star locations, planetary images, comet and asteroid trajectories, and satellite locations are among many of the common elements of a basic show. How-

New Faculty Member to Join Department

The physics department is very pleased to announce the hiring of Dr. Surujhdeo (Suruj) Seunarine into a tenure-track assistant professor position.

This position is a result of Jim Madsen’s new role with the IceCube project down in Madison. As he will no longer be teaching classes at UWRF (though he will remain the department chair), we needed someone to take on his course load. In addition to teaching, a big part of this new position is going to be working with UWRF students who are doing research with the IceCube project.

Suruj comes to UWRF via the University of the West Indies at Cave Hill, Barbados where he has been a Physics Lecturer. A native of the West Indies, Suruj has lived in Italy and the U.S. while finishing his education, and has worked at the University of Canterbury in New Zealand.

The next newsletter will have more information about Suruj as he settles into this new position.
ever, any data or images can be converted for use in the software. The operator can use pre-programmed shows, or can create their own show. Because the system is connected to the network, it is also possible to simulcast shows produced at other planetariums around the world.

One of the anticipated uses of the new system will be to present information generated by the IceCube Neutrino observatory at the South Pole to the public and be to present information generated by the IceCube observatory at the University of Wisconsin System to broaden the impact of this new facility beyond River Falls.

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Spring Semester Student Projects

This semester’s senior seminar projects were a mixture of new projects and projects that were continuations of work first started by previous students. But, as always, there are a wide range of topics represented:

Matthew Wolf used his seminar project to get a jump start on the work he’ll be doing as a graduate student starting in the summer. He’ll be a graduate student in the Engineering Physics department at UW-Madison working with UWRF alum Dr. Mark Anderson (1994). Matthew’s research will involve studies of supercritical fluids - fluids at high temperatures and pressures above the critical point where it is impossible to discern a phase transition between the liquid and gas phases. One of the tools he will be using is Raman Spectroscopy, an optical technique that can determine the vibrational modes of molecules. The Raman spectrum of a molecule depends on the pressure and temperature of the molecule, so this technique can be used to remotely detect the pressure and temperature of a molecule. To get started in this work, Matthew investigated the pressure dependence of the Raman spectrum of liquid water, using some equipment generously loaned to him by Mark.

In a completely different project, Amanda Steck also investigated the Raman spectrum of water. Here, however, the water was not in a pressurized container. Rather, the water was in the form of a single micron-sized droplet that was trapped in the UWRF optical trapping system. In this system, a single, highly-focused laser beam is used to grab and hold small water droplets to be examined individually. Amanda’s project involved modifying the optical trap to be able to simultaneously view the droplet using infrared light and collecting the Raman scattered light into a spectrometer. Because the droplets are perfectly spherical due to the surface tension of water, standing light waves are created on the surface of the droplet at specific frequencies determined by the size of the droplet. From these measurements, the radius of the droplet can be determined to within a fraction of a micrometer.

Josh Anderson picked up a project investigating water drops on Leidenfrost ratchets that Jacob Noble began last semester. The Leidenfrost effect occurs when a liquid is placed onto a surface that is well above the liquid’s boiling point. The droplet ends up riding on a cushion of vapor allowing the droplet to move over the surface with very little friction. In this experiment the hot surface was a piece of brass whose surface has been milled into the profile of a ratchet (sawtooth). Droplets placed on this surface are accelerated in one direction due to the shape of the ratchet. Josh extended this work to investigate the temperature dependence of the terminal velocity of the water droplets.

Although it may have seemed that Michael McAllister had created a very poorly-behaved electric circuit, he was actually quite happy when it produced seemingly random signals. The circuit he was modeling is called Chua’s Circuit and is one of the classic examples of a real system that exhibits chaotic behavior. Chaotic systems are deterministic, meaning that there is a set of equations that describe how they behave. The equations can be quite complex, but they can be solved numerically to get a good idea of how the system will behave over time.

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2012-13 Scholarship Winners Announced

At the annual Spring Banquet, the continuing students who have been awarded scholarships for the 2011-2012 year were announced. They are:

Charlotte Evans  EARL G. ALBERT SCHOLARSHIP
Theodore McDonough  EARL G. ALBERT SCHOLARSHIP
Katrina Hanson  DR. HENRY TRANMAL SCHOLARSHIP
Noah Biro  CURT AND DEE LARSON SCHOLARSHIP

Also, two incoming students have been awarded Physics Alumni Scholarships:

Joseph Faella is from West Salem, WI and he attended West Salem High School.
Gillian McDonald’s is from St. Paul, MN and she attended Irondale Senior High School in Mounds View.
the system changes in time, but they are highly sensitive to the initial conditions of the system. In other words, if a tiny change is made to the initial voltage applied to the circuit, the circuit’s behavior at a later time will change dramatically. Michael simulated the behavior of this circuit, and with the help of his lab partner from Advanced Lab, Mitch Elmgren, they also created a working version of the circuit as well.

Kathleen Vignali has always been interested in the practical aspects of solar power, and when she would drive past a solar panel on her way to check on her horse at the University Lab Farm, she wondered how much the panel’s past a solar panel on her way to check on her horse at the University Lab Farm, she wondered how much the panel’s efficiency was improved by having it track the sun throughout the day. Working on a smaller scale, Kathleen examined the power output of a fixed solar cell at various orientations and compared its efficiency to that of a solar cell that tracked the motion of the Sun through the use of a pair of photoresistors and a stepper motor. She found that tracking the Sun lead to a 13% increase in the efficiency.

Expanding on some of his work at 3M, James Rust measured the output of an array of ultraviolet (UV) light emitting diodes (LEDs) as the temperature of the diodes was varied. Many industrial processes require a highly stable UV light source, and maintaining the LEDs at a constant temperature is key to their stability. James investigated the energy density of the output of the array as a function of temperature, while simultaneously testing different cooling methods using air or water as the cooling medium.

Motivated by both a desire to learn more about equipment control, and to work on a project that will benefit other students in the future, Scott Clarke worked to obtain computer control over a pair of linear translation stages that were donated a year ago. Dedicated readers of the Physics Newsletter may recall that Preco, Inc. (facilitated by alumnus Jason Thoen) donated a CO2 laser and translation stages to the Physics department so that students could develop a laser machining station. Scott procured a digital motion controller and was able to demonstrate accurate control of a single translation stage. He did leave room for future students, as we still need an additional amplifier to have full two-axis motion using both stages, and a procedure needs to be developed to take designs from a CAD program and convert them to motion commands to control the stages. We are looking forward to the day when students can design a part and cut it out with the CO2 laser themselves.

Alex Jewell attempted to demonstrate levitation using sound waves. By creating a standing sound wave between a transducer and a flat plate, it is possible to generate an oscillating pressure that is large enough to suspend small objects (up to the size of a small frog at high enough powers) against the force of gravity. The process is used in research and some industrial processes where, for example, a material needs to be melted without letting it touch any surfaces. Alex was ultimately unsuccessful in levitating an object, mostly because he did not have access to an amplifier that would produce enough power in the ultrasonic frequency range that he was working in.

In addition to the seminar projects, several groups in the Advanced Lab course also undertook projects this past semester. In an extension of Scott Clarke’s seminar project, he and Alesha Radke worked with the CO2 laser to begin characterizing the laser’s ability to cut Lexan, a common plastic. They first designed and built a sturdy unistrut structure to hold both the laser and the pair of translation stages that will move the material to be cut. Since Scott was able to control one axis of motion, he and Alesha were able to characterize the depth and profile of the cuts they made in the Lexan as they varied the speed of the plastic as it moved through the focused laser beam. They also devised a duct system (using duct tape) to ventilate the fumes from the cutting to a fume hood.

Charlotte Evans and James Rust measured the mobility of electrons in n-doped silicon semiconductors. They used a combination of 4-terminal resistance measurements to measure the conductivity of their samples and Hall Effect measurements to determine the concentration of the conduction electrons. As anyone who has tried to make electrical connections to Silicon knows, Charlotte and James spent a lot of time learning good techniques for connecting wires to their samples.

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News & Notes

- Matt Vonk will be presenting a workshop at the 2012 Conference on Laboratory Instruction Beyond the First Year of College (BFY for short). The faculty from around the nation who attend his workshop will gain hands-on experience using Field Programmable Gate Arrays (FPGAs) so that they can incorporate them into their own classes.

- UWRF alumnus Peter Bohacek, now a physics teacher at Henry Sibley High School in Mendota Heights, MN, will be teaching a class at UWRF this summer. The class is one of the summer courses for high school teachers offered by the physics department each year. Peter will be demonstrating how to use video clips effectively both in a classroom setting and as a part of homework assignments, where students make measurements from the videos and do some analysis. One example video can be found at: tinyurl.com/BohacekVideo

- A number of students will be off working at internships or undergraduate research programs over the summer.
  - Charlotte Evans - Colorado School of Mines
  - William Ryan - UW-Madison
  - Tyler Capek - Milwaukee School of Engineering
  - Rory Jones - Univ. of North Dakota
  - Emil Dvorak, Theodore McDonough - UWRF IceCube

- Students who graduated this past year and who decided to go on to graduate school include:
  - Katelyn Schramke, Kathleen Vignali - Univ. of Minnesota, Mechanical Engineering
  - Abby Pederson - Colorado State, Health Physics
  - Matthew Wolf - UW-Madison, Engineering Physics
  - Kyle Jero - UW-Madison, Physics
  - Amanda Steck - Univ. of Nebraska, Physics

Physics Puzzler

This is a piece of equipment from our stockroom. The puzzle is simple - what is it and how does it work? A winner will be chosen at random from the correct answers that are submitted to: Lowell.McCann@uwrf.edu. (There is a prize, and emeriti faculty are not eligible!)

2012 Sigma Pi Sigma Honors Society Inductees

2012 Sigma Pi Sigma Inductees from UWRF - Back row from left: Derek Bauer, Noah Biro, Peter Brudzinski, Daniel Frank, Kathleen Vignali, Thomas Langley. Front row, from left: Jedith Hanson, Joseph DeCarlo, Jacob Olson, Matthew Schmitt. Not pictured: William Ryan.
Larson and Prochnow Honored with Service Awards

At the Physics department banquet this spring, two people familiar to many readers of this newsletter were honored for their contributions to the department. Curt Larson and Neal Prochnow, were awarded the Sigma Pi Sigma Outstanding Service Award. These awards are given by the national Sigma Pi Sigma Honors Society, at the request of the local chapters.

Larson and Prochnow were both charter members of the UWRF chapter of Sigma Pi Sigma, and both were highly supportive of the group while they were on the faculty. Since their retirements, both have continued to remain actively involved in the physics program and highly supportive of the students.

Every summer, Curt Larson has worked with the summer program for high school teachers as a volunteer - helping the students in the evenings as they work through their coursework. He and his wife Dee also support a scholarship for continuing physics majors.

Recently, Neal Prochnow has become involved in recruiting efforts for the physics department, trying to help maintain the flow of good students into the Physics and pre-Engineering programs at UWRF. Neal and his wife Caren also support a scholarship for students in the College of Arts and Sciences.