2011 Research at Andrews

Andrews University

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Dear Friends of Andrews University:

Welcome to our second annual publication, Research and Creative Scholarship at Andrews University, Summer 2011. In the following pages, you will see highlights of a few of the ongoing research projects at Andrews University. These projects range from a quantitative analysis of the effectiveness of the Seventh-day Adventist primary and secondary education system to a search for gravitational ripples in the fabric of the universe. The multi-disciplinary nature of research is evidenced in the work of Jacques Doukhoun to promote greater Jewish-Christian understanding, and in the work of Øystein LaBianca to develop an integrated approach to the “little traditions” illuminated by ancient Middle Eastern archaeology.

Andrews University is composed of inquisitive spirits and investigative minds. Therefore, a distinguishing attribute of Andrews University is the infusion of research and creative scholarship into its academic fabric. Research and creative scholarship permeate our academic life, inform our teaching and strengthen our emphasis on generous service. Research is always a collaborative endeavor. Faculty members participate in interdisciplinary collaborations, and students are mentored by their teachers in the intricacies of conducting research.

Siegfried H. Horn (1904–1993), my teacher, colleague and friend, set a wonderful example of what it means to be an Andrews scholar. By pioneering an interdisciplinary approach to archaeology in the Middle East, Siegfried Horn transformed the field of biblical archaeology and influenced the careers of scores of his students who continue projects he started. In recognition of Siegfried Horn’s contribution to scholarship, we have established an Excellence in Research and Creative Scholarship Award in his name. More about Siegfried Horn’s career and the first recipients of the Excellence award are presented on pages 13–15.

A recent report indicated that universities need to prepare students for careers that do not yet exist and to use technologies that have not yet been invented in order to solve problems that we are not yet aware of. At Andrews University, we believe one way to prepare students to meet this challenge is to equip them with the skills to conduct research. Students who have learned to solve problems by means of well-designed research processes will be equipped to face new challenges for the rest of their lives.

I hope you enjoy this second annual presentation of some of the ongoing research programs of our faculty and students.

Cordially,

Niel Erik Andreasen
President

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Hearing the Cosmic Violin

Tiffany Summerscales

The Search for Gravitational Waves

If a tree fell in the forest outside Livingston, La., and there was no one to hear it, the four-kilometer-long LIGO detectors would hear the sound it made. The L-shaped configuration of mirrors and lasers is trained to pick up gravitational waves, ripples in the fabric of space-time predicted by Einstein’s theory of relativity. These detectors are sensitive enough to pick up gravitational waves, but that also means they pick up any vibrations in the surrounding area. “We can tell when rush hour starts in the area because the detector output increases at a certain frequency,” says Tiffany Summerscales, associate professor of physics. She is a collaborator on the Laser Interferometer Gravitational Wave Observatory (LIGO) project, part of which is taking place in the physics laboratory at Andrews University.

According to Einstein’s theory of relativity, which treats space as if it were a flexible membrane, gravity is a dimple in the fabric, and objects are attracted to the nearest dimple. A change in the arrangement of the objects creates gravitational waves and causes a change in the dimples and send out ripples—gravitational waves. These waves cannot be detected with traditional instruments. The LIGO project was initially begun in 1994 in Hanford, Wash. Its two LIGO detectors in Hanford, and Livingston, as well as the Virgo detector in Cascina, Italy and GEO600 detector near Hanover, Germany, measure changes in distance that two laser beams travel. “Any tiny change in distance along the arm can be measured,” says Summerscales. “And we’re measuring changes in distance that are smaller than the diameter of a proton.” The detectors produce immense data readout, consisting of a mixture of noise and gravitational wave signals. Different objects produce different types of gravitational waves. Two objects orbiting each other, a neutron star and black hole for example, will spin faster and faster until their orbits combine. This gravitational wave appears as a “chirp” on the sensor. Supernova explosions would go “pop,” and a dense star with a bump on its side emits one constant sound. (Summerscales makes a few chirps and “woos” for illustration.)

Gravitational waves are inferred from the observed behavior of neutron stars orbiting each other. The star’s loss energy and move closer together exactly as predicted if they were emitting that energy in the form of gravitational waves. However, gravitational waves have yet to be directly detected. After six “science runs” beginning in 2003 to calibrate and test the LIGO detectors, they were taken offline for updates and repairs in 2010. The upgraded detectors, with much greater sensitivity to detect gravitational waves, are expected to become operational in 2015.

The LIGO team’s mission is to first detect all these kinds of gravitational waves and then separate them from the noise signals produced from “tumbleweed collection or underwater disturbances.”

...continued on page 13–15...

Above and following page: Diagram and photos of the LIGO Hanford Observatory in Hanford, Wash. (Courtesy LIGO Laboratory)