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Research / Discovery

Professors receive \$1 million Keck Foundation grant to visualize molecules in live tissues

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Randy Bartels and Stu Tobet, professors in the School of Biomedical Engineering, have received a highly competitive \$1 million Keck Foundation grant to create a microscope that could, for the first time, "see" characteristics of molecules that tell other molecules what to do.

These signaling molecules control biological behaviors spanning from basic human development to attack from toxins. The molecules are so tiny that not even dye techniques – known as fluorescence – used to light up tiny particles can reveal their properties, said Randy Bartels, [electrical engineering](#) professor and the principal investigator on the grant.



Randy Bartels, electrical engineering professor

Signaling molecules give new level of understanding

"This would give a new window into the fundamental level of molecular communication in biology," Bartels said. "It could potentially have an impact on understanding the underlying molecular biology of cancer, which could suggest new treatments."

Bartels will test his microscope in the laboratory of Stu Tobet, director of the university's [School of Biomedical Engineering](#) and a professor in the College of [Veterinary Medicine and Biomedical Sciences](#). Tobet's research focuses on how cells define a growing and maturing brain.

High-risk, high-return research

The [Keck Foundation](#) is known for funding high-risk, high-return projects in science, engineering and medical research.

"Finding the answers to biomedical questions using engineering solutions, a primary focus for CSU's School of Biomedical Engineering, could yield essential discovery while providing strong opportunities for economic growth in Colorado's bioengineering field," said Colorado State President Tony Frank. "We are grateful to the W.M. Keck Foundation for its support of research at Colorado State University and the groundbreaking work of Drs. Bartels and Tobet.

"Over the last decade, CSU has been honored to receive four grants totaling nearly \$4 million from the Keck Foundation in such diverse areas as physics, biochemistry, and electrical and computer engineering. This is a testament to the fact that our students are learning from some of the top scientists in their fields."

New Keck laboratory planned in Engineering II

With the grant, Bartels and Tobet will create the Keck Laboratory for Ultrasensitive Raman Microscopy in the College of Engineering, where they will test the Keck Microscope using live tissue samples. The laboratory will be housed in the new Engineering building scheduled for

groundbreaking this spring at the southeast corner of Laurel Street and Meridian Avenue.

Bartels is also on the faculty in the School of Biomedical Engineering, which was the first in the state to offer graduate degrees in bioengineering beginning in 2007. In fall 2011, the university will add a new undergraduate degree in biomedical engineering, one of the very few dual-degree, undergraduate biomedical engineering programs offered in the Western United States.

“One of our major problems in biology and biomedical sciences is to visualize the molecules that drive cell functions and communication,” Tobet said. “This is particularly important in understanding the developing nervous system, where molecules provide cues to determine how the brain develops.

“My laboratory has developed ways to visualize cells functions and movements live in tissue slices that model the way things occur in the body. This project will create a tool to visualize these molecules as they carry out their business in real time.”

The Keck project was enabled by early funding from the Beckman Foundation, which allowed Bartels to develop a research effort in new types of nonlinear microscopy for biomedical applications.

How do multiple signals affect cell position?

Tobet’s research focuses on how multiple signals affect migration and cell position in the developing nervous system, particularly the migratory behavior of cells that contribute to sex differences in structure or function. He also investigates the differences between the two sexes in the ability to protect and recover from internal and external assaults including brain injuries that occur during development or the harmful influences of environmental toxicants.

Tobet’s numerous awards and honors include serving as a member NSF and NIH Review Panels and as a member of four editorial boards including Endocrinology and Journal of Neuroendocrinology. His research efforts have been continuously funded by NSF, NIH or foundations since 1989. He has also been honored with the Outstanding Academic Advising Award in Graduate Education by the College of Veterinary Medicine and Biomedical Sciences.

Bartels’ work has generated many discoveries in diverse fields. He heads Colorado State’s Laboratory for Ultrafast and Nonlinear Optics, where his research concentrates on the generation and control of short laser pulses and their use for the control of quantum dynamics - to precisely control the positions of atoms in molecules, for example. His research group is funded by the Office of Naval Research developing new laser technology for the next generation of precision clocks, which have shown significantly more laser precision than standard atomic clocks. He also has funding from NIH, DOE, and NSF.



Stu Tobet, veterinary medicine and biomedical sciences professor

Bartels decorated with Presidential Early Career Award

In 2006, President George W. Bush awarded Bartels a Presidential Early Career Award - the U.S. government’s highest honor for outstanding up-and-coming scientists and engineers. Bartels was one of only 56 scientists from around the country who received the award.

“Since joining Colorado State in 2003, Dr. Bartels has been awarded millions of dollars in grants for his cutting-edge research. He has obtained numerous awards in engineering, physics, chemistry, computer science and optics. CSU is very pleased to be able to partner with Keck Foundation to continue to support his successful research,” said William Farland, vice president for Research at Colorado State.

Most recently, Bartels was named a Fellow in the Optical Society of America, but he is also a Kavli fellow of the National Academies of Science; a recipient of the Sloan Research Fellow in physics,

one of the oldest and most prestigious research honors in the nation; a Beckman Young Investigator Award from the Arnold and Mabel Beckman Foundation; the Gold Medal Human-Competitive Award; the Optical Society of America Adolph Lomb Medal; the IEEE Photonics Society Young Investigator Award; an Office of Naval Research Young Investigator Award; and an NSF Faculty Early Career Development Award. Bartels is a past recipient of the prestigious Monfort Professor Award, one of Colorado State's top honors.

The W.M. Keck Foundation was established in 1954 by the late William Myron Keck, founder of The Superior Oil Co., and is one of the nation's leading private sponsors of cutting-edge scientific research. The foundation makes grants in four program areas: Science and Engineering Research, Medical Research, Undergraduate Education, and Southern California. By funding the work of leading researchers, the establishment of unique laboratories and research centers and the purchase of sophisticated instruments, the foundation seeks breakthrough discoveries and new technologies that will save lives, provide innovative solutions to complex problems and add immeasurably to understanding life on Earth.

Contact: Emily Wilmsen
E-mail: Emily.Wilmsen@colostate.edu
Phone: (970) 491-2336

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