Newsletter

College of Physical and Mathematical Sciences

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In this issue:

Venus Express will take BYU mirror to space

By Grant Madsen

Oct. 28, 2005

One and a half years after a mirror created by Brigham Young University students left Earth onboard the European Space Agency s Mars Express spacecraft, a second mirror this one on the Venus Express will be launched from Baikonur, Kazakhstan.

Astronomers will use the spacecraft s seven instruments to determine why a planet so similar to Earth in terms of orbit, size and mass is so inhospitable. The BYU mirror is part of the ASPERA device designed to measure the rate at which Venus atmosphere is being eroded by solar winds, which has implications for Earth s own weather system. ASPERA stands for analyzer of space plasma and energetic atoms.

BYU Student Amy Baker was part of a team of undergraduates who built a specially coated mirror that will be launched into spaced onboard the Venus Express. Baker is shown here with the device used to apply the mirror's coating of chromium and magnesium fluoride

Students did great work on this, and we are all very excited to see the fruits of their labors go into space, said David Allred, professor of physics and project advisor. For the undergraduates who got to be involved in research, this is about the coolest thing they could imagine. It s really a once-in-a-career experience for them to have something they've worked on orbit another planet.

The BYU students contribution to the ASPERA makes the instrument s readings accurate and useable for scientific interpretation. Sarah Barton, Chris Verharen, Niki Brimhall and Amy Baker were the students who worked on the project.

It s really a neat thing to know that something I helped build will be orbiting Venus, taking measurements, said Barton. Some of the other projects I've worked on are a little less glamorous and a little less understandable, but people can visualize this project, which is nice for a change.

Baker added, It was interesting to collaborate with the European Space Agency and get another take on things. The experience has given me confidence that the work I produce is useful to other people.

The students started in winter of last year by reformulating a special coating for the mirror. This finish of chromium and magnesium fluoride was formed using evaporation. Inside a vacuum chamber, the mirror s titanium base was held over an intense heat source. When the chromium and magnesium fluoride came in contact with the heat, they evaporated and adhered to the titanium.

Those are fairly common materials, but students figured out the most effective mixture and method for coating the mirror, said Allred.

The European Space Agency has built the Venus Express using much of the design of its predecessor, the Mars Express. The newer ship has been adjusted to allow it to face Venus environment. However, the BYU-built mirror on board the Venus Express is identical to the one students built for the ASPERA device currently orbiting Mars.

Venus, which has temperatures that hover at 450 degrees Celsius and a carbon dioxide atmosphere that rains sulfuric acid, is a bit of a mystery, said Allred. The mission will provide the most comprehensive study of the planet s atmosphere, which is an example of runaway global warming.

People usually think of erosion as wind or water removing soil, but planetary scientists also talk about solar wind and how it can erode things it comes in contact with, said Allred. In the case of Venus, hydrogen and oxygen atoms are being knocked farther into space. If it weren't t for that, they might recombine and remain on the planet.

Earth has a magnetic field which helps prevent the same type of erosion from taking place, while Mars and Venus do not, said Allred.

Earth is special, said Allred. And what scientists are trying to determine with these spacecraft is why has our planet been so hospitable to life for such a long time. Did Mars or Venus ever have life and then the planets went bad? If so what made them go bad? If we can answer those questions, then perhaps we'll be able to do something to prevent the same situation on Earth.

Researchers speed up drug production time

By Grant Madsen

Oct. 21, 2005

BYU researchers have developed a method of producing synthetic molecules that will allow pharmaceutical companies to make certain prescription drugs more efficiently, including a forthcoming class of Type II diabetes medications.

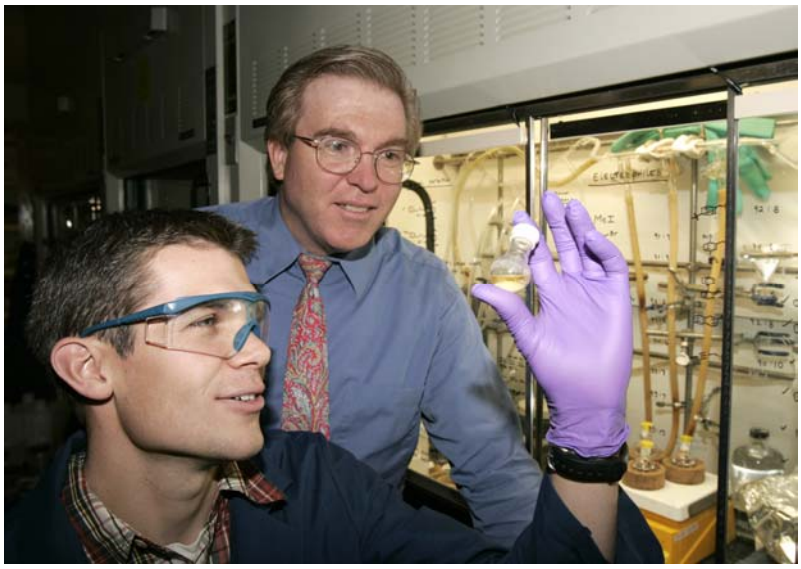
"The current process involved in the creation of these drugs, which have the potential to benefit so many, is wasteful," said Merritt Andrus, professor of chemistry." Our method minimizes the time needed to create an effective batch of the key molecules used in these types of drugs."

A study detailing the new methods appears in the latest issues of the *Journal of Organic Chemistry*. Harvard-bound graduate student Erik Hicken and undergraduates Jeff Stevens and Karl Bedke join Andrus on the study as co-authors.

David MacMillan, the Earl C. Anthony professor of organic chemistry at the California Institute of Technology, says Andrus' development of the new chemical reaction has broad implications for chemistry and biology.

"Dr. Andrus has employed lateral thinking, also known as great creativity, to find a solution to a long-standing problem that involves a chemical product widely used in the discovery and production of medicinal agents," said MacMillan.

"As such, Andrus' research in this area will gain wide attention from many scientists in the pharmaceutical industry," he said.



Student Karl Bedke (left) and Dr. Merritt Andrus have developed a method of producing synthetic molecules to allow pharmaceutical companies to make certain drugs more efficiently, including an upcoming class of diabetes medications.

The research team's focus was on the molecules in a forthcoming class of diabetes medications that helps increase the amount of insulin produced in the pancreas while decreasing sugar levels in the body. These molecules, called chiral molecules, exist in "left- and right-handed" forms.

Only one of the molecule's forms produces the intended effects in the human body and is therefore vital to the creation of the drug. The second form is inactive and must be discarded.

Until now, pharmaceutical companies had to create the chiral molecules indiscriminately and dispose of the ineffective, useless part.

"From a business standpoint, this is just like throwing away half of your inventory and can be rather costly," said Andrus, whose team developed a way to ensure all of the chiral molecules produced for such medications are potent.

To do so, Andrus employed part of an inexpensive molecule related to quinine, known for its antimalarial properties, that exhibits only "one-handedness" to force chiral molecules to form in their effective state.

Martin J. O'Donnell is a professor of chemistry and chemical biology at Indiana University-Purdue University Indianapolis and a pioneer in the use of the same quinine catalysts whom Andrus employed in his research.

"Professor Andrus and his research group's novel chemistry represents a highly significant scientific contribution and has been applied to the total synthesis of a compound being studied for the treatment of diabetes," said O'Donnell.

"The nice thing about what we've done is that it's a broad method that all drug companies could use," said Andrus, adding that he and graduate student Hicken has already synthesized a new anticancer compound and have plans for anti-inflammation compounds in the works.

Even with the excitement surrounding his success in the laboratory, Andrus is even more pleased with another result– Hicken will attend Harvard in 2006 to work with Nobel Prize winning scientist E.J. Corey, arguably the top organic chemist in the world, partially because of the work Hicken has done at BYU.

"This is the biggest reward there is– to place students in important places," said Andrus. "To see the success of the people who have worked with you is by far the most satisfying thing I experience as a professor."

Awards in Sponsored Research at Brigham Young University

Oct. 21, 2005

Howard B. Christensen

Creative Works Recognition Award

Howard B. Christensen is in his 39th year as a faculty member in the Department of Statistics at Brigham Young University. He has invested much of his career in teaching and developing introductory statistics courses, in particular Statistics 221. He was involved in a curriculum development program in the early 1970s that led to the publication of an introductory textbook, *Statistics Step by Step*, by Houghton Mifflin.

In the early 1980s Dr. Christensen developed a department course for Statistics 321, a calculus-based introductory course that led to a second textbook, *Introduction to Statistics: A Calculus-Based Approach*, published by Sauders/HBJ.

Dr. Christensen's work with Patti Collings, on what ultimately became StatTutor, began in the late 1990s and represents a comprehensive computer-based instructional package with animations, applets, videos, and a supporting audio-track. Additional pedagogical features have been added to enhance its value to the self-learner as well as the traditional learner. This packaged is being marketed with several of W.H. Freeman Publisher's textbooks and has the ability to impact thousands of students in introductory courses around the country.

Dr. Christensen and his wife, Bonnie, are the parents of eleven children and have 32 grandchildren. He notes that one of his joys in life is being among the first to hold a newly born grandchild as they are brought into a loving family. Family activities and events are an important part of his life.

Paul B. Savage

Technology Transfer Recognition Award

Paul B. Savage was born and raised in Flagstaff, Arizona, where his father was on the faculty in the Department of Chemistry and Biochemistry at Northern Arizona University. His mother taught at Leupp Public School on the Navajo Reservation. He received his BS Degree from BYU in Chemistry in 1988, his Ph.D. from the University of Wisconsin 1993, and after postdoctoral studies at Ohio State University, his tenure began at BYU in 1995. He is now an Associate Chair in the Department of Chemistry and Biochemistry. He is fortunate to be married to Valerie and they have six wonderful children: Scott, Margaret, Hannah, Esther, Sarah, and Eleanor.

Through the tireless effort of many undergraduate, graduate, and postdoctoral students, some potentially marketable developments have been made in Dr. Savage's laboratory. This group has discovered and optimized a new class of antibiotics that mimics that bactericidal activities of endogenous peptide antibiotics. These new antibiotics have been licensed to Ceragenix Pharmaceuticals, a company focusing on products in dermatology, oncology, and infectious disease. Dr. Savage's group has also been involved in determining and optimizing structures of glycolipids that can stimulate cytokine release from natural killer T cells. This cell type regulates immune responses, and glycolipids have proven useful in eliciting specific responses in animal models of human disease.

Patti Burton Collings

Creative Works Recognition Award

Patti Burton Collings is a professor in the Department of Statistics at BYU. She has taught introductory statistics for over thirty years and has had the opportunity to teach and tutor thousands of students. In her one-on-one tutoring she has enjoyed learning from her students about which concepts are difficult and what their misconceptions are.

Along with other faculty in the Department of Statistics, Dr. Collings has spent many hours producing the StatTutor lessons, such as self-assessment quizzes, detailed homework solutions, a glossary, study guides, and practice exams. Her sincere hope is that the StatTutor lessons, the quizzes, and all the other helps will help students to better learn statistics.

Dr. Collings is married to Bruce Jay Collings, who is also a professor in the Department of Statistics at BYU. Her husband has helped her immensely in preparing the Independent Study course. They are the parents of four wonderful children, two daughters, and two sons. Their children are all married, adding tow more daughters and two more sons to the family. They have four wonderful grandchildren. In her spare time Dr. Collings enjoys listening to music, reading, sewing, and gardening.

College Publications

Chemistry

A. Trokhymchuk, I. Nezbeda, J. Jirsak, and D.J. Henderson, "Hard Sphere Radial Distribution Function Again", *J. Chem. Physics*, **123** (2005).

C.M. Stetson, S. Nishikawa, D.W. Purkiss, N.K. Dalley, and R.A. Bartsch, "Synthesis and Evaluation of New Ditopic Cyclophanse Receptors for Benzoic Acid", *J. Phys. Org. Chem*., **18**, 1107-1115 (2005).

D. Boda, D. Gillespie, B. Eisenberg, W. Nonner, and D.J. Henderson, "The Induced Charge Computation Method and its Application in Monte Carlo Simulations of Inhomogeneous Dielectric Systems", chapter in Ionic Soft Matter: Novel Trends in Theory and Applications, NATO Science Series, Henderson, et al., Eds., Kluwer-Springer, Amsterdam 2005, pp. 19-43.

D.J. Henderson, A. Trokhymchuk, and M. Holovko, Ionic Soft Matter: Novel Trends in Theory and Applications, NATO Science Series, Kluwer-Springer, Amsterdam (2005).

D.J. Henderson, D. Gillespie, T. Nagy, and D. Boda, "Monte Carlo Simulation of the Electric Double Layer: Dielectric Boundaries and the Effects of Induced Charge", *Mol. Physics*, **103**, 2851-2861 (2005).

L. He., G.S.C. Srikanth, and S.L. Castle, "Synthesis of $-Substituted "-Amino Acids via Lewis Acid Promoted Enantioselective Radical Conjugate Additions", *J. Org. Chem.,* **70**(20), 8140-8147 (2005).

R.G. Harrison, J.L. Burrows, and L.D. Hansen, "Selective Guest Encapsulation by a Cobalt-Assembled Cage Molecule", *Chem. Eur. J*., **11**, 5881-5888 (2005).

R.S. Criddle, L.D. Hansen, B.N. Smith, C. Macfarlane, J.N. Church, T. Thygerson, T. Jovanovic, and T. Booth, "Thermodynamic Law for Adaptation of Plants to Environmental Temperatures", *Pure Appl. Chem.,* **77**(8), 1425-1444 (2005).

Computer Science

M. J. Al-Muhammed, D. W. Embley, and S. W. Liddle, "Conceptual Model Based Semantic Web Services", In *Proceedings of the 24th International Conference on Conceptual Modeling (ER 2005)*, Klagenfurt, Austria, 24-28 October 2005, 288-303.

Reema Al-Kamha, David W. Embley, and Stephen W. Liddle, "Representing Generalization/Specialization in XML Schema", in *Proceedings of the Workshop on Enterprise Modeling and Information Systems Architectures (EMISA 2005)*, Klagenfurt, Austria, 24-25 October 2005, 250-263.

Y.A. Tijerino, D.W. Embley, D.W. Lonsdale, Y. Ding, and G. Nagy, "Toward Ontology Generation from Tables", In *World Wide Web: Internet and Web Information Systems*, **8**(3), 261-285 (2005).

Geology

A. D. Anderson, and B. J. Kowallis, "Storm Deposited Fish Debris in the Cretaceous Mowry Shale Near Vernal, Utah", *Uinta Mountain Geology: Utah Geological Association Publication*, **33**, 125-130 (2005).

B. J. Kowallis, and T. D. Bradfield, "Landslide Hazards Along the Southern Flank of the Uinta Mountains", *Uinta Mountain Geology: Utah Geological Association Publication*, **33**, 255-261 (2005).

B. J. Kowallis, E. H Christiansen, E. Balls, M. T. Heizler, and D. A. Sprinkel, "The Bishop Conglomerate Ash Beds, South Flank of the Uinta Mountains, Utah: Are They Pyroclastic Fall Beds from the Oligocene Ignimbrites of Western Utah and Eastern Nevada?", *Uinta Mountain Geology: Utah Geological Association Publication*, **33**, 131-145 (2005).

C.M. Dehler, J. L. Pederson, D. A. Sprinkel, and B. J. Kowallis, *Uinta Mountain Geology: Utah Geological Association Publication*, **33**, (2005).

D. A. Haddox, B. J. Kowallis, and J. D. Shakespeare, "Mapping and Kinematic Analysis of the Deep Creek Fault Zone, South Flank of the Uinta Mountains, Utah", *Uinta Mountain Geology: Utah Geological Association Publication*, **33**, 321-333 (2005).

D. A. Sprinkel, B. J. Kowallis, J. L. Pederson, and C. M. Dehler, "Road Guide to the Geology of the Uinta Mountains for the 2005 Utah Geological Association Field Conference", *Uinta Mountain Geology: Utah Geological Association Publication*, **33**, 397-448 (2005).

P. H. Jensen, and B. J. Kowallis, "Piecing Together the Triassic/Jurassic Stratigraphy Along the South Flank of the Uinta Mountains, Northeast Utah: A Preliminary Analysis", *Uinta Mountain Geology: Utah Geological Association Publication*, **33**, 99-109 (2005).

T. H. Morris, J. H. McBride and W. D. Monn, "A Multidisciplinary Approach to Reservoir Characterization of the Entrada Erg-Margin Gas Play, Utah", *Utah Geological Survey,* Open-File Report, **459,** (CD), (2005).

Physics

T. B. Neilsen, "Localization of multiple acoustic sources in the shallow ocean", *J. Acoust. Soc. Am*., **118**(5), 2944-2953 (2005).

T. W. Leishman and J. Tichy, "An experimental investigation of two active segmented partition arrays", *Journal of the Acoustical Society of America*, **118**, 3050-3063 (2005).