may 2011

FACULTY newsletter

CPMS Physical and Mathematical Sciences

ABOVE Dr. Brian Anderson

Visiting Professor Prepares for Future

In just two short years at CPMS, visiting physics professor Brian Anderson has pursued several significant acoustics research projects, developed as a dedicated classroom instructor, and shown tireless dedication to his students – a solid reputation he will soon take with him into a world of new opportunities.

After receiving both his bachelor's and master's degrees in physics from BYU in 2001 and 2003, respectively, Anderson harbored a keen interest in teaching at his alma mater. He finally got his chance in January 2009 when, as a result of Scott Sommerfeldt's appointment as CPMS dean, the Department of Physics and Astronomy created a visiting professor position to provide additional teaching and research support to the Acoustics Research Group.

During his time in Provo, Anderson has performed research on several acoustics-related topics with the help of his student research assistants. Anderson, who received his Ph.D. in acoustics from Pennsylvania State University in 2006, says one of his highest priorities as a professor is to assist his students in producing publishable research. To date, a paper has been published, submitted or is in preparation for each student he has worked with at BYU.

"What sets BYU apart is the students," Anderson said. "The dedication and maturity of the students makes mentoring them very enjoyable and has allowed me to learn from them as well."

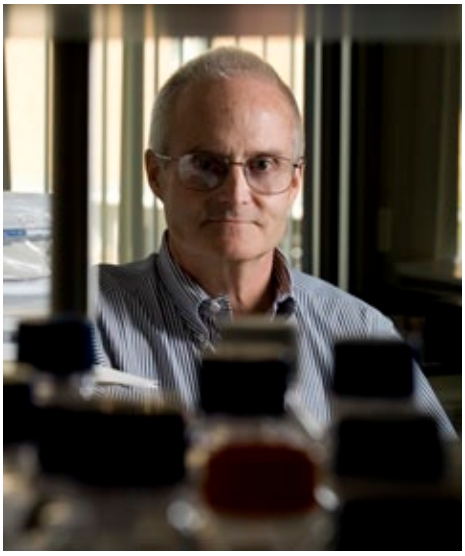
In addition to his research, Anderson has also taught multiple physics classes, including Physics 167, 561, and 660. He tries to incorporate demonstrations and examples into his lectures to help illustrate difficult concepts, and he often uses YouTube videos to quiz, instruct, and entertain his students.

While Anderson said he has enjoyed his time at BYU and wishes he could stay longer, his contract with the school is scheduled to end in August 2011. He has already been invited to interview for several opportunities at various academic and research institutions.

"I'm looking for the right fit among academic positions or a full-time research position that could be of use if I make my way back into academia," he said.

Wherever Anderson, his wife Angela, and their three children land, his future employers will be lucky to have this dedicated educator and researcher – a truth many in Provo know all too well.

by: Steve Pierce



ABOVE Dr. Greg Burton Photo: Jaron Wilkey/BYU

Putting the Chemical Brakes on HIV & AIDS

1.8 million people died of AIDS in 2009 alone, according to a report by the United Nations.

Though no cure currently exists for HIV or AIDS, Greg Burton and Barry Willardson of the Department of Chemistry and Biochemistry, in conjunction with Xueyuan Zhou, a doctoral student and Gilbert Fellingham of the Department of Statistics recently published an article about HIV replication, which could assist in someday discovering a cure for this pandemic.

The group based their study on the fact that AAT (a normal protein in humans) stops the replication of HIV. Using an idea from a previously published study by another research group, the BYU team looked at the effects of AAT on FDC-mediated HIV replication. Follicular dendritic cells, or FDCs, are specialized cells that serve as "HIV reservoirs" where the virus is caught and stored in the tissues of infected individuals.

Through a series of experiments, the BYU scientists discovered that AAT inhibited replication in these HIV reservoirs. Since these areas typically produce three to four times more viruses than other sites within the body, this is a significant discovery.

"At this point in time, the data suggest that AAT is a molecule that may be effective in lowering the production

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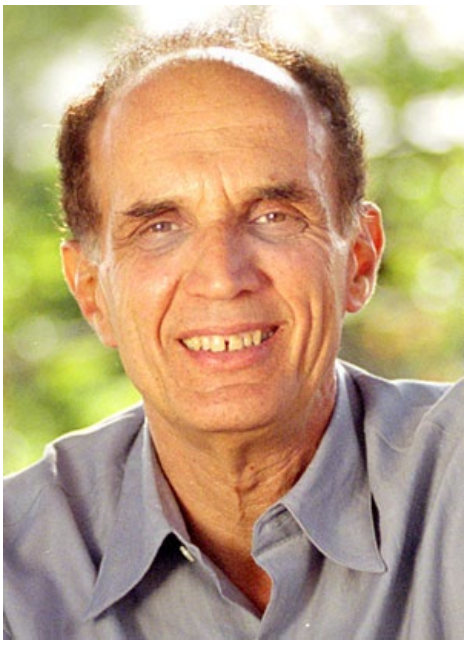

ABOVE Dr. Bradley Efron

Dates To Remember

Last day of Spring Classes
Monday, June 13

Finals for Spring Term
Wednesday & Thursday, June 15-16

36th Annual Summer Institute of Applied Statistics
Wednesday-Friday, June 15-17

First day of Summer Term
Monday, June 20

Spring Term Grades Due
Friday, June 24

Learning From the Best: A Visit From Dr. Efron

Listen to the CPMS News Podcast with Dr. Efron at cpms.byu.edu/learning-from-the-best/

A highly noted statistician visited BYU earlier this month, giving students valuable knowledge for their future careers. Bradley Efron, of Stanford University's Department of Statistics, spoke at a statistics seminar on April 7. He also toured BYU's campus, met with several statistics professors, and learned about research going on at BYU.

Evan Johnson, a BYU statistics professor who attended the lecture, said he believes a visit from a famous statistician like Efron helps students get ahead in their education and careers.

"We brought somebody out who is a very high quality statistician to see what BYU is all about," said Johnson. "[He] got to see the quality of our statistics department."

Johnson said that BYU's Department of Statistics believes that a good education includes propelling students forward in their careers. Exposure to important statisticians from around the world helps to accomplish that goal.

"Our major goals [are] to train our students, get them jobs in statistics, and get them into good Ph.D. programs," said Johnson. "If famous statisticians come, they'll see how great BYU is and how great our students are."

Doug VanDerwerken, a graduate student in the statistics department, said he came to the lecture to see how Efron would explain complicated concepts to students who are relatively new to the field.

"I think that an important part of statistics, or any discipline, is being able to explain things," VanDerwerken said. "I thought he did a very good job of explaining something that's very difficult in a way that we could understand it."

During his lecture, Efron described one way statisticians calculate accurate estimates from large amounts of data. The method uses a combination of both the Bayesian and frequentist approaches to statistics, called an empirical Bayes approach.

Efron explained that in many studies, extreme data gets the most attention. As a statistician, he said his goal is to figure out which extremes occur by chance, and then to find an accurate way to estimate what the average is.

"If I only had one or two [pieces of data], I could probably make a correction [using purely frequentist methods], but if I have 1,000 values, that's impossible," Efron said. "An empirical Bayes approach actually gets somewhere."

VanDerwerken said he enjoyed learning about a concept that was new to him. In the future, he said he will know where to go for help when he has problems in statistics like those discussed by Efron.

"I'm not an expert in what [Efron] shared today, but if I ever come across a similar problem I know where I can go to find more information on that," VanDerwerken said. "If somebody's already done the work there's no need for you to do it again."

by: Erik Westesen

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of HIV in infected individuals," Burton said. "Moreover, our current studies are examining the potential of AAT to affect the FDC itself in a manner that may decrease its ability to help the virus persist in infected subjects."

The group also discovered that the reason AAT stops the production of HIV is because it blocks the activation of NF-kB, a crucial factor needed for HIV to copy itself. This, coupled with their discovery of how to stop FDCs from serving as an important HIV reservoir, could help reveal a method of halting the replication of HIV in these reservoirs.

"We believe that the FDC plays an important role in the propagation of HIV and in its persistence within humans," Burton said.

"We are excited that this molecule may actually alter the ability of the FDC to 'help' the virus," he said, "If our postulates are true, this may have broad ramifications for not only HIV/AIDS, but also allergy and autoimmunity."

by: Alysa Hoskin

ABOVE Dr. Jaron Hansen

Renewable Energy From China's Waste

Two BYU chemistry professors have been using their knowledge of bacteria to turn waste into energy for quite some time, and now they're taking their craft on the road – to China!

Jaron Hansen, a professor in the Department of Chemistry and Biochemistry, and Lee Hansen, an emeritus faculty member from the same department, recently traveled to the world's most populous country to unveil the biogas conditioning system they built for the Chinese government.

The conditioner is currently being installed on a dairy farm outside Shanghai and will function as part of a larger anaerobic digestion system to produce renewable energy for on-site use. This system will also include two large Induced Bed Reactors (or IBRs), which will be used to turn cow manure into methane gas. The professors' biogas conditioner will then purify that gas, stripping out any harmful elements and converting it into compressed natural gas that can be used to power the dairy's vehicles.

During their time in China, the professors will attend a ribbon-cutting ceremony to unveil the new system. They will be joined at the ceremony by Utah Governor Gary Herbert, who will attend as part of a previously scheduled economic trip to the country, as well as several Chinese provincial governors.

"I'm delighted to be able to participate in this event during our trade mission to China," Herbert said of the ceremony. "This project embodies Utah's entrepreneurial spirit of innovation and partnership, and I commend both Dr. Jaron Hansen and Dr. Lee Hansen for their hard work and determination that ensured this day would come to fruition."

The professors will stay in China for 10 days in order to install the biogas conditioner and make sure the whole system runs smoothly. But Jaron Hansen is less concerned about the product working than he is about actually getting it into the country.

The professors will stay in China for 10 days in order to install the biogas conditioner and make sure the whole system runs smoothly. But Jaron Hansen is less concerned about the product working than he is about actually getting it into the country.

"Then again," Hansen added, whimsically, "it also weighs 1,000 pounds, which is a quite a bit more than what I weigh."

Any shipping costs, however, are only temporary concerns that won't deter either of these professors – Jaron Hansen says the pair currently plan to install up to three additional biogas conditioning systems in the Shanghai area in 2011.

"It's absolutely worth it," he said of the time and energy expended on each system. "We're making the world a better place!"

by: Steve Pierce

ABOVE Dr. David Wright

Theoretical Concepts — Real Discoveries

Blinded in the First World War at age 29, Louis Antoine was a French mathematician who struggled to cope with his newly darkened world. Sensing his friend's need for new purpose, Henri Lebesgue suggested that Antoine begin studying two- and three-dimensional mathematical objects. What resulted was the discovery of Antoine's necklace.

Antoine's necklace is a theoretical object in three-dimensional space that modern mathematicians continue to study. David Wright, a faculty member in the Department of Mathematics, has undertaken a study that builds upon the existing known properties of this object.

An easy way to visualize this necklace is to imagine a rock that has been chiseled away to create a chain of unbroken links. Then, each of these links is chiseled into a miniature necklace, whose links are then chiseled into other necklaces, and so forth. This pattern continues indefinitely.

Though it seems fragile, a physical replica of Antoine's necklace wouldn't fall apart.

"If you put your fingers around its outermost link and tried to pick [Antoine's necklace] up," Wright explained, "it might shift a little bit just like some beads would, but it would not fall through your fingers."

Similar to Antoine's necklace, the Bing-Whitehead necklace is the focus of Wright's research project. However, the Bing-Whitehead pattern is not formed by chiseling, but by intertwining Bing

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College Grants

Chemistry & Biochemistry

Emily Bates
Sponsor: American Headache Society
Title: Finding the Molecular Mechanism of Casein Kinase I Delta Mediated Migraine

Computer Science

Dan Ventura
Sponsor: NSF
Title: International Conference on Computational Creativity: Broadening Participation

Mathematics

Roger Baker
Sponsor: NSA
Title: Hooley's Exponential Sum: Primes in Arithmetic Progressions

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BRIGHAM YOUNG UNIVERSITY

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and Whitehead links, which are large and delicate. Imagine twisting two rubber bands together, or one rubber band around itself, to make different structures.

Another difference between these two necklaces is their stability. The beginning Bing-Whitehead links easily disentangle themselves and fall apart when gently shaken. However, if these graceful links are repeatedly woven together, the first few links may fall apart, but it is impossible to untangle all of them.

Wright studied the effect that different combinations of Bing and Whitehead links would have on a finished product. He sought to discover whether wrapping these links in different patterns, or codes, would create different necklaces.

This problem also interested three other mathematicians, one from Oregon and two from Slovenia. In collaboration with these sharp minds, Wright was able to solve the problem and determined that constructing Bing-Whitehead necklaces according to different codes really do produce different necklaces. These findings were published in the Transactions of the American Mathematical Society.

by: Natalie Wilson

College Publications

Chemistry and Biochemistry

L.B. Bhuiyan, D. Henderson, "A Local Semi-empirical Contact Condition for the Charge Profile in an Electric Double Layer with Size-asymmetric Ions at Low Electrode Charge", Molecular Simulation, 2011, volume 37/issue 4, pp. 269-276

D. Henderson, D. Boda, "Mean Spherical Approximation for the Yukawa Fluid Radial Distribution Function", Molecular Physics, 2011, volume 109, pp. 1009-1013

R. Johne, P. Otto, B. Roth, U. Löhren, D. Belnap, J. Reetz, E. Trojnar, "Sequence Analysis of the VP6-encoding Genome Segment of Avian Group F and G Rotaviruses", The Journal of Virology, 2011, volume 412, pp. 384-391

A.G. Johnson, B.M. Loertscher, A.R. Moeck, S.S. Matthews, D. Ess, S. Castle, "Experimental and Theoretical Investigation of the Scope of Enantioselective Ketone Allylations Employing Nakamura's Allylzinc-bisoxazoline Reagent", Bioorganic and Medicinal Chemistry Letters, 2011, volume 21, pp. 2706-2710

B.H. Kirk, D. Ess, "Quantum Mechanical Inspection of the Diels-Alder Approach to Biaryls Mechanism", Tetrahedron Letters, 2011, volume 52, pp. 1245-1249

S. Lamperski, D. Henderson, "Simulation Study of Capacitance of the Double Layer of an Electrolyte Near a Highly Charged Electrode", Molecular Simulation, 2011, volume 37/issue 4, pp. 264-268

J. Liu, Y. Geng, E. Pound, S. Gyawali, J.R. Ashton, J. Hickey, A. Woolley, J.N. Harb, "Metallization of Branched DNA Origami for Nanoelectronic Circuit Fabrication", ACS Nano, 2011, volume 5/issue3, pp. 2240-2247

A. Paul, J.F. Hull, M.R. Norris, Z. Chen, D. Ess, J.J. Concepcion, T.J. Meyer, "Multiple Pathways for Benzyl Alcohol Oxidation by RuV=O3+ and RuIV=O2+ ", Inorganic Chemistry, 2011, volume 50, pp. 1167-1169

P.S. Stewart, M. Chen, W.R. Roush, D. Ess, "Thermodynamic Control of 1,3-Boratropic Shifts of α- and g-Stannyl-Substituted Allylboranes: Hyperconjugation Outweighs Steric Effects", Organic Letters, 2011, volume 13, pp. 1478-1481

Mathematics

W. Barrett, S. Gibelyou, M. Kempton, N. Malloy, C. Nelson, W. Sexton, J. Sinkovic, "The Inverse Eigenvalue and Inertia Problems for Minimum Rank Two Graphs", Electronic Journal of Linear Algebra, 2011, volume 22, pp. 389-418

W. Barrett, H.T. Hall, H.V.D. Holst, "The Inertia Set of the Join of Graphs", Linear Algebra and Its Applications, 2011, volume 434/issue 10, pp. 2197-2203