PHYSICS *at SMU*

An occasional newsletter for alumni and friends. **Fall 2009**

Chairman's Report

Another year has passed quickly. For the Physics Department this was a year of a beginning of diversification. For over 15 years the research was focused on only one project at a time. In contrast, the physics graduate students who came to SMU in Fall of 2009 will be able to choose among seven different projects for their theses: study of high-energy proton-proton collisions with ATLAS at LHC, proton-antiproton collisions with D0 at Fermilab, electron-positron collisions with BaBar at SLAC, neutrino physics with NOvA at Fermilab, a dark matter search with CDMS in the Soudan mine in Minnesota, development of the ebubble – the cryogenic device for detecting neutrinos from the Sun – and finally development of the superfast electronics for digital data transfers. This diversification was assisted by two new faculty members who joined the department in August 2009. The department's computing facility received a substantial boost by the grants of $200,000 from the office of the SMU Provost and $924,000 from the Department of Energy. Finally, many activities in the Department would not be possible without the generous support of the Lightner-Sams Foundation and of the Tittle fund established by Dedman College trustee Dr. Robert Mayer.

- Ryszard Stroynowski

FACULTY NEWS

The department is very pleased to welcome our new faculty members:

Jodi Cooley-Sekula
Assistant Professor of Experimental Physics

Jodi Cooley-Sekula received her Ph.D. degree in 2003 at the University of Wisconsin and had postdoctoral appointments at MIT and at Stanford University. She has been the Physics analysis coordinator for the CDMS collaboration that uses germanium detectors at low temperatures to search for effects of the primordial dark matter remaining from the original Big Bang. She is forming a new research group at SMU and creating a research laboratory that will continue development of the detection techniques for the dark matter searches.

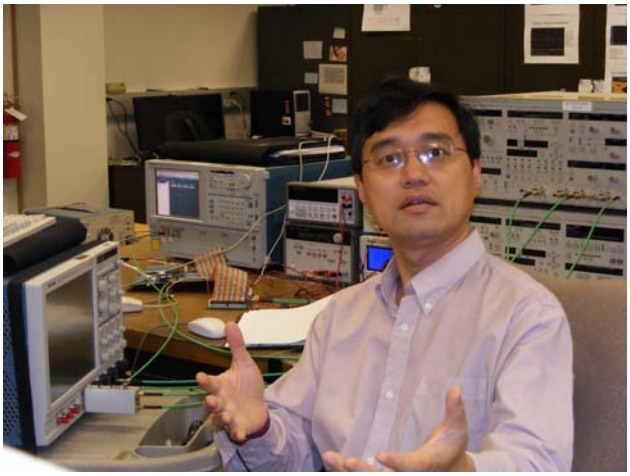
Published by the Department of Physics, Dedman College, Southern Methodist University

Stephen Sekula

Assistant Professor of Experimental Physics

Stephen Sekula received his Ph.D. degree in 2005 at the University of Wisconsin and had postdoctoral appointments at MIT and at Ohio State University. He led the search for new physics phenomena with the BaBar detector at SLAC and joined the ATLAS Collaboration where he plans to search for dark matter produced at the Large Hadron Collider.

Professor Fredrick Olness started his term as President of the SMU Faculty Senate with a call to lift SMU to the Tier 1 ranking. Such ranking would reflect the status of Dallas as not only one of the top ten populous urban metroplexes in the US but also as a first class intellectual center.



Jingbo Ye receives tenure

In May 2009 all members of the Physics Department celebrated the approval by the SMU Board of Trustees of the promotion and tenure decision of Professor Jingbo Ye.

Ford Research Fellowship

Fred Olness was one of the four recipients of the prestigious 2009 Gerald J. Ford Research Fellowship and medal.

In the photo above, the medalists: Ben Johnson (History), Carolyn Smith-Morris (Anthropology), Fredrick Olness (Physics) and Larry Ruben (Biological Sciences) are standing together with President Gerald Turner (far right) and Gerald J. Ford (far left).

UNDERGRADUATE PROGRAM

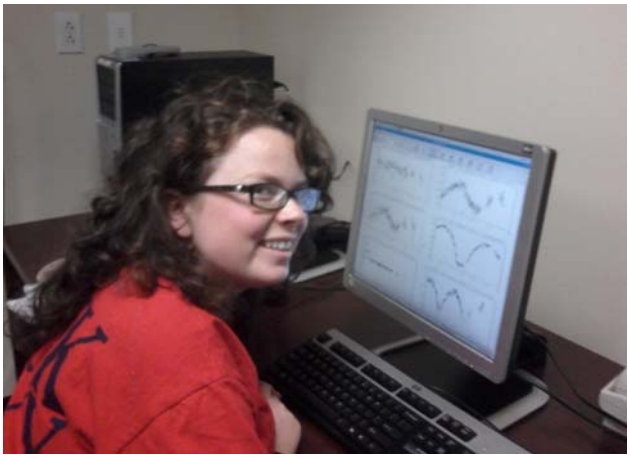
The Undergraduate Research Program initiated in 2005 has attracted several students who work on a variety of projects ranging from development of techniques to measure very small electric currents, measurement of the magnetic properties of the cosmic ray muons to the searches for variable stars using robotic telescope data.

Undergraduate students find 20 new variable stars

The department's project engaging students in a search for variable stars has been gaining momentum. Started by **Courtney Fagg** and **Kelly Pearson** two years ago, and joined by **Jieun Park** last year, the students use archival data taken with a robotic telescope in New Mexico. This device was designed to constantly monitor the night sky to identify bursts of optical light from gamma-ray bursts -- some of the most extreme celestial cataclysms known.

The students are able to look at this data in a new way and identify more regular stars that nevertheless show rapid changes in brightness. Several previously unknown variable stars have been identified. They exhibit enormous variations in light, up to 80%, in as little as two hours. The students analyze the data and learn about the underlying physics of different species of these variable stars.

The first refereed paper on a subset of the data was accepted for publication this Fall. Two additional students – **Jonathan Fleming** and **Vladimir Jovanovic** have also joined Pearson and Park continuing in this effort. Current efforts involve finishing the analysis of the original data, and readying software so that data from a more powerful, existing telescope at McDonald Observatory can be used.



Kelly Pearson in front of a display with a newly discovered star with rapid change of its brightness.

Awards and Honors

Amy Hand was our department's 2008-2009 recipient of the Robert Stewart Hyer Scholarship Award and **Ken Ueda** was the 2008-2009 recipient of the Frank C. McDonald Memorial Award for Excellence in Physics.

Society of Physics Students

Thanks to the generous support of the Lightner-Sams Foundation, the Society of Physics Students have organized a trip each year to one of the National Laboratories for several members of the Society of Physics Students. Past trips included Stanford Linear Accelerator Center in California, Brookhaven National Laboratory on Long Island, NY and Fermilab near Chicago. The target of the most recent trip was The European Laboratory For Nuclear Research, CERN in Geneva, Switzerland, home of the Large Hadron Collider.

SMU Society of Physics Students Trip to CERN

Matthew Rispoli, Brian Crouch, Vladimir Jovanovic, Mat Busby, Amy Hand, Tim Fedorov, Mariam Ishaque, & ATLAS detector.

In December 2008, members of the Society together with **Dr. Simon Dalley** visited CERN, the European Organization for Nuclear Research located in Geneva, Switzerland. The visit occurred a few months after the first successful beam operation at the Large Hadron Collider (LHC), part of the largest and most complicated experiment in history, whose principal goal is to find the Higgs Boson believed to be the origin of mass.

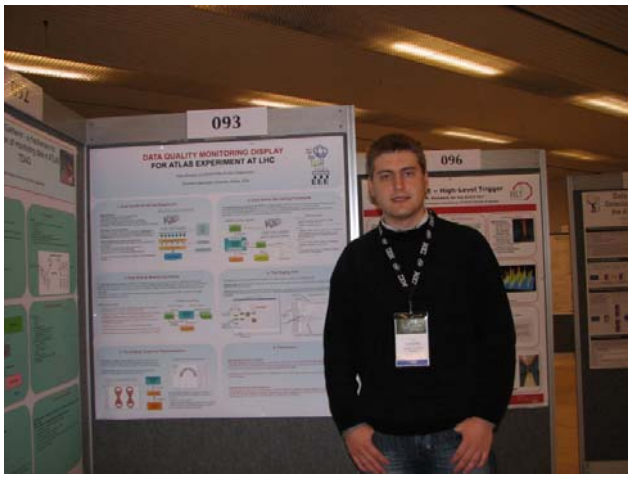
SMU postdoc **Julia Hoffman** took them 100m down into the cavern – the size of Fondren Science building – that houses ATLAS, one of two general purpose detectors for the LHC, which SMU faculty and students helped to build and operate. Such are the extreme conditions under which ATLAS operates, that elaborate procedures were necessary to gain entry to the experiment. Afterwards, they toured the Microcosm exhibition of CERN history and then had lunch in the famous CERN cafeteria, where many important ideas are hatched. SPS members also visited the United Nations, the Alps, and took a gastronomic excursion to the old town of Annecy in France.

For many students it was their first trip to Europe with new experiences, such as taking a bus, walking, and slow food.

…plus SPS President Ken Ueda (2nd left) next to LHC magnet exhibit.

GRADUATE PROGRAM

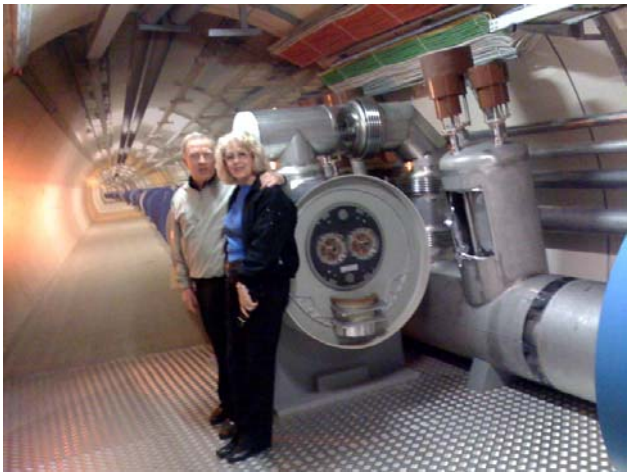
For the past three years **Yuriy Ilchenko** has been working on the ATLAS experiment. Together with Professor Robert Kehoe and Research Associate Haleh Hadavand, he developed a scheme to monitor the quality of the data streaming out of the millions of channels of the ATLAS readout system. Since the ATLAS experiment is designed to search for very rare events to be selected from thousands of proton-proton collisions occurring every second, it is important to identify all hardware glitches that can confuse the search. He presented this scheme at the CHEP'09 International Conference in Prague, Czech Republic in February.



Lightner-Sams Graduate Fellowships

For the past several years the Lightner-Sams Foundation has provided funds for one-time fellowships for promising graduate students in Physics. This year's recipients are **Zhihua Liang** and **Yichen Li**. Zhihua is working on the theoretical calculations describing rates of particles production at the Large Hadron Collider expected from the known process of strong interactions. Yichen is developing the electronic readout system for e-bubble – a project to detect neutrinos produced at the center of our Sun.

Larry and Sue Lightner visited with other Lightner-Sams fellows during their visit to CERN in Geneva, Switzerland.



Larry and Sue Lightner in front of the mockup of the accelerator section in the CERN Microcosm museum.

Larry Lightner in the ATLAS detector underground cavern.

RESEARCH PROGRAM

The department continues its strong research programs in Experimental and Theoretical high-energy physics. The experimental group is active in several projects: D-Zero takes data at the Fermilab Tevatron, ATLAS is one of the main experiments at the Large Hadron Collider at CERN, and preparations for several future projects are well underway.

The following article by Margaret Allen has appeared at the SMU blog: http://www.smuresearch.com

Hunt for Higgs boson: Mass of top quark narrows search

By Margaret Allen

New high-energy particle research by a team working with data from Fermi National Accelerator Laboratory further heightens the uncertainty about the exact nature of a key theoretical component of modern physics — the massive fundamental particle called the Higgs boson. Analysis of data from particle collisions resulting in two leptons helps improve measurements of the mass of another heavy sub atomic particle called the top quark, says physicist Robert Kehoe at SMU, who led the team that calculated the measurement. Improving the measurement of the mass of the top quark bears on the nature of the Higgs, says Kehoe, an assistant professor in SMU's Department of Physics.

The Higgs was postulated in the 1960s to help explain how basic elements of the universe fit together and interact. It is responsible for a phenomenon called the Higgs mechanism, which gives mass to the fundamental particles of nature.

Physicists have searched for more than four decades to observe the never-before-seen Higgs. Now they hope it will be observed in the next few years since data started flowing recently from the world's newest and largest high-energy particle accelerator, the Large Hadron Collider at the CERN laboratory near Geneva, Switzerland.

Physicists theorize that the top quark — because of its sizable mass — is sensitive to the Higgs and therefore may point to it. They theorize that knowing the mass of the top quark narrows the range of where the Higgs will be detected in CERN's LHC collisions. The top quark is one of 16 species of subatomic particles that physicists have observed. It was predicted in the 1970s and observed in 1995. Increasingly precise measurements of its mass have been achieved almost every year since, and physicists closely watch the incremental measurements of the top quark.

D-Zero Detector. Source: Fermilab

The two-lepton analysis by Kehoe and SMU post-doctoral researcher Peter Renkel looked at data taken over four years during high-energy collisions at Fermilab, a Department of Energy proton-antiproton collider in Batavia, Ill.

The two-lepton analysis is one of almost a dozen analyses of the mass of the top quark at a Fermilab experiment called "D-Zero." The D-Zero experiment involves 500 physicists and is one of Fermilab's two large experimental collaborations of scientists. The top quark mass was first observed simultaneously by these two experiments. Several measurements of the top quark's mass from these two experiments are combined to a "world average" value.

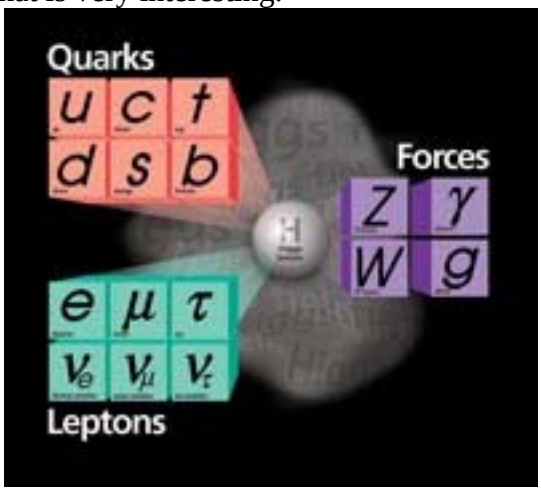
Fermilab's D-Zero control room. Source: Fermilab

The two-lepton analysis contributed to the latest "world average" measurement. The analysis looked at particles resulting from smashing protons that break apart and disintegrate. The events are very rare, and the detector can't see two of the important "ghost" particles — neutrinos — produced by the collision. However, the two leptons are well-measured events and are not seen in other "background" collisions where top quarks are not produced. This allows a rapidly improving precision to be achieved.

The two-lepton research was published in November in the article "Measurement of the top quark mass in final states with two leptons" in "Physical Review D," the American Physical Society's journal of particles, fields, gravitation and cosmology. SMU physicists collaborated on the research with scientists at Boston University. The SMU portion of the work was funded by the Department of Energy.

The new "world average" is so precise that it constrains more tightly than ever the range of possible measurements for the mass of the Higgs, Kehoe says. If the Higgs does prove different than currently expected, physicists may have to rework their long-standing theoretical framework, known as the Standard Model. Scientists worldwide are hoping to validate the Standard Model — which has worked well for more than 30 years to explain everything from radioactivity to computer chips — by actually observing the Higgs.

"The new results may be an indication that the Higgs boson has different properties than the Standard Model indicates," Kehoe says. "It's very difficult to devise a theory without some mechanism that mimics fairly well the Higgs mechanism. But if the underlying cause of this mechanism is significantly different, that will have a major impact on the fundamentals of the Standard Model. It could point to something deeper than the standard Higgs boson at work, and that is very interesting."



Standard Model fundamental particles.

The measured value of the top quark mass may even go beyond constraining the standard Higgs. It may suggest that our current understanding of the Higgs is not correct, he says. If the Higgs does not show up where the constraints indicate, the top measurement may force consideration of new theoretical possibilities that lie outside the existing Standard Model, Kehoe says.

Previous measurements have put the top quark at almost the mass of a gold atom. The new "world average" measurement puts the top quark at about 186 times the mass of the proton. While the value has changed only a small amount from previous measurements, the percentage of error on the measurement is progressively smaller, in this case less than 1 percent. "If we make a precise prediction of where the Higgs is and it's not there, then something is wrong. We've just found a major flaw in the model," says Kehoe, whose work has focused for 16 years on the top quark, including as a graduate student on D-Zero working directly on the discovery analysis. "It would tell us that the model is oversimplified and that reality is much more complicated."

COMMUNITY OUTREACH

The Physics Department is promoting a number of community outreach projects.

High School Teachers Meet Cutting-Edge Physics at SMU's Dedman College

DALLAS (SMU) -- Southern Methodist University has been offering its QuarkNet program to Dallas-area high school teachers since 2001. This summer, 15 teachers were invited to campus to learn about recent discoveries in physics through lectures and hands-on labs conducted by scientists from the Physics Department in Dedman College chaired by Dr. Ryszard Stroynowski.

Gail Rothstein, a physics teacher at Townview Magnet Center in Dallas ISD who has participated for several years, was one of those attending the one-week workshop led by Dedman College faculty members Simon Dalley, Fred Olness, and Randy Scalise. She wrote that this was "the best QuarkNet yet. The lecturers and presentations were engaging and informative". Another high school teacher, Linda Treadaway from Wylie East High School, commented that "because I don't have a true physics background, I come to QuarkNet to be "fed". One of the things I appreciate about the lectures is that they aren't so far above my understanding that I can't follow them."

SMU faculty gave lectures on their current interests, ranging from particle accelerators such as the Large Hadron Collider, the interface of nuclear physics with society, and spooky action-at-a-distance phenomena predicted by modern theories of physics. Teachers also got to build their own particle accelerators using powerful Neodymium mini-magnets and bits and pieces from local hardware stores.

The program is sponsored by the prestigious National Science Foundation, the Office of High Energy Physics and the Office of Science at the U.S. Department of Energy. Summing up the experience for all the participants, Dirk Preble from Legacy Christian Academy in Frisco commented that "the QuarkNet workshop does an outstanding job of preparing teachers. This reflects highly on SMU and the Department of Physics at SMU".

SCIENCE FAIR 2009

The venue for the Beal Bank 2009 Dallas Regional Science & Engineering Fair

Faculty and staff of the SMU Physics Department organized the 2009 Beal Bank Dallas Regional Science & Engineering Fair. Nearly 900 middle and high school students and 350 judges from the Dallas area registered for the Fair, a large increase over recent years. They gathered at Fair Park on February 28 to exhibit and compete for $100,000 in prizes. Competition winners, together with their parents and teachers, were later hosted on the SMU campus at an awards banquet for over 400 people in Hughes-Trigg student center.

Prof. Dalley, Fair President, commented, "These events not only contribute to the educational vitality of the local community, but also enable students, parents and teachers to learn about SMU as a possible college destination through presentations, tours, and direct contact with SMU faculty."

Multiple award-winning projects this year included a study of problems posed by cholera bacteria in a proposed mosquito predator, simulations of magnetically targeted drugs in the bloodstream and effects of solar wind on magnetic devices.

Pictured is Prof. Olness, Fair Vice-President, displaying his preferred mode of transport in the huge exhibition arena at Fair Park. In terms of quantity and quality of research projects, many agreed that this had been the best Fair for several years.

Award winners from the 2009 Dallas Regional Science & Engineering Fair organized by the SMU Physics Department

Start of the Construction of NOvA experiment

Produced in the Big Bang 14 billion years ago and copiously produced today in stars such as our Sun, neutrinos are some of Nature's most exotic elementary particles. Electrically neutral and capable of travelling through nearly a light year of lead before interacting with matter, they are notoriously difficult to detect but are thought to be a key player in explaining the mystery of why our universe contains any matter at all, and not just pure light. Another of their mysteries is their ability to oscillate or morph from one "flavor" into another, akin to a tiger morphing into a house cat.

Professor Thomas Coan leads SMU's participation in "NOvA," a collaborative neutrino oscillation experiment funded by the US Department of Energy's Office of Science. Based at Fermi National Accelerator Laboratory near Chicago, the collaboration is building a 14,000 ton detector in northern Minnesota to search for the never-before-observed oscillation of muon-type neutrinos into electron-type neutrinos.

The figure shows an aerial view of the construction site in late fall 2009.

ALUMNI NEWS

Matthew Knee (MS 2004) writes:

"Well, I started a new job last year but became a casualty of the economic troubles. I decided that I wanted to find a teaching position overseas since I had been thinking about doing that for a little while. I then found that there was a math teaching position opening at The American School in Switzerland so I went for it because I had taught math before, I really like Switzerland. They liked me and I was lucky enough to be hired. I really like it here so far. It is beautiful, the school is nice, and the students are really great.

One of the really neat things about the school is the academic travel. We have about a week each semester where faculty take students to various places to learn outside the classroom. I have been lucky enough, with my physics background, to be assigned as a chaperone on the physics trip to CERN. I am very excited about this because I haven't been there since I went there for my research."

Matthew Knee (back row center) with his students in Lugano, Switzerland.

Yon Cole (MS 2006) writes:

Yon Cole is working as a Reliability Engineer for Envoy Medical Corporation of St. Paul, MN - the maker of a premier Fully Implanted Hearing Restoration System, currently in Phase III clinical trial on track for FDA Premarket Approval. At Envoy, Mr. Cole conducts Risk Management and Hazard Analysis functions; designs, conducts, and reports on Accelerated Life Testing to demonstrate product reliability; and performs analysis of product returns to isolate root causes - all tasks that benefit from the strong analytical and organizational skills enhanced by his Masters Degree in Physics earned at SMU in 2006. Yon is a proud father of identical twin daughters born in 2007, and husband to his loving wife Lisa Cole who received her Masters Degree in Music from SMU.

Martina Kolmeder (BS 2000)

Martina Kolmeder is using the technical and problem solving skills of her degree as President of **MARTINASWEB.COM** a small Web and Database Design & Photography company she founded over 8 years ago. When asked about her time at SMU she said, "I am so grateful for the time and dedication of all the professors who put up with me. My physics degree has been an invaluable asset to my professional growth, not to mention it's great street cred."

Reed Johnson (BS 2003)

Reed Johnson is President and CEO of TRU3D, INC a technology startup dedicated to bring 3D technology out of the movie theaters and into homes and offices. TRU3D systems allow the visualization of almost any type of professional data from AutoCAD to medical MRI data. We've worked with a variety of companies from New Mexico Super Computing Center to Disney's Pixar. Our home solutions allow users to watch DVD's in 3D, Hulu and other windows media files, play video games and coming soon, Blu-Ray and live HD conversion. Reed has partnered with Tony Welch, SMU ‘04 Computer Engineering, who is acting as CTO. Our professional and home products will become available Dec ‘09 and can be found at www.tru3d.com.

April Kramer Andreas (BA 2002)

“**Derek** (BA 2002) is working at Space Exploration Technologies (SpaceX) and is designing and building test stands for the rocket engines and components. He's awesome. I taught a class at SMU TAG this summer called "Mars or Bust: Creating a Permanent Martian Settlement." I'm working at McLennan Community College, and trying to build an engineering program from scratch! Our kiddo, Kivan, just turned 2 and although he still confuses red and green, he knows all his planets! (Nerds!)”

Paul Hartin (BS 2007)

In May 2008 I finished my EE masters and in June 2008 I got married (to Lauren). I'm still working at Raytheon in McKinney.

Thank You For Keeping In Touch:

Thanks to all of you who updated your contact information for our records. You can find recent news at our web page at

http://www.physics.smu.edu/

We request that you:

- Inform us of any address changes in the future so we can stay in touch.
- Send us your e-mail address for future Physics Department Newsletters.
- Put us in touch with others who would like to receive the Physics Newsletter.
- Help us recruit both undergraduate and graduate students by putting us in touch with any prospective candidates.

CONTACT INFORMATION

Our contact address & phone:

SMU Physics Department
PO Box 0175
Dallas, TX 75275-0175
info@physics.smu.edu

Phone: (214) 768-2495
Fax: (214) 768-4095
Web: http://www.physics.smu.edu