PHYSICS *at SMU*

An occasional newsletter for alumni and friends. **Spring 2013**

Chairman's Report

This has been busy and exciting year for our department. As we begin the Spring semester, we have much to report.

2012 saw the discovery of the Higgs Boson at the Large Hadron Collider (LHC) at the CERN Laboratory in Geneva, Switzerland. ***Science*** magazine calls this the **"Breakthrough of the Year."** To celebrate this momentous achievement, our 2013 **Lightner-Sams Symposium** will focus on the Higgs discovery, and look at the role SMU physicists played. *(Details & reservation information on page 2.)*

Professor **Jodi Cooley** received a Career Award from the National Science Foundation, and this will provide $1 million of support for her research program on the study of dark matter. Recall that Professor **Pavel Nadolsky** recently received an Early Career Research Award (ECRA) from the US Department of Energy.

Professor **Robert Kehoe** was named the SMU Director of Undergraduate Research and will be coordinating with programs across campus to expand the research opportunities for our undergraduate students.

Professor **Stephen Sekula** received the 2013 Golden Mustang Award. This award is presented annually to junior faculty whose teaching is consistently excellent; whose courses reflect thoughtful curricular development; and whose scholarship makes a meaningful contribution to the discipline and to student learning.

SMU Physics Alumnus Dr. **Alonso Gutierrez** visited campus last spring to present a seminar on Medical Physics, and then returned in October to receive the prestigious 2012 SMU Emerging Leader Award.

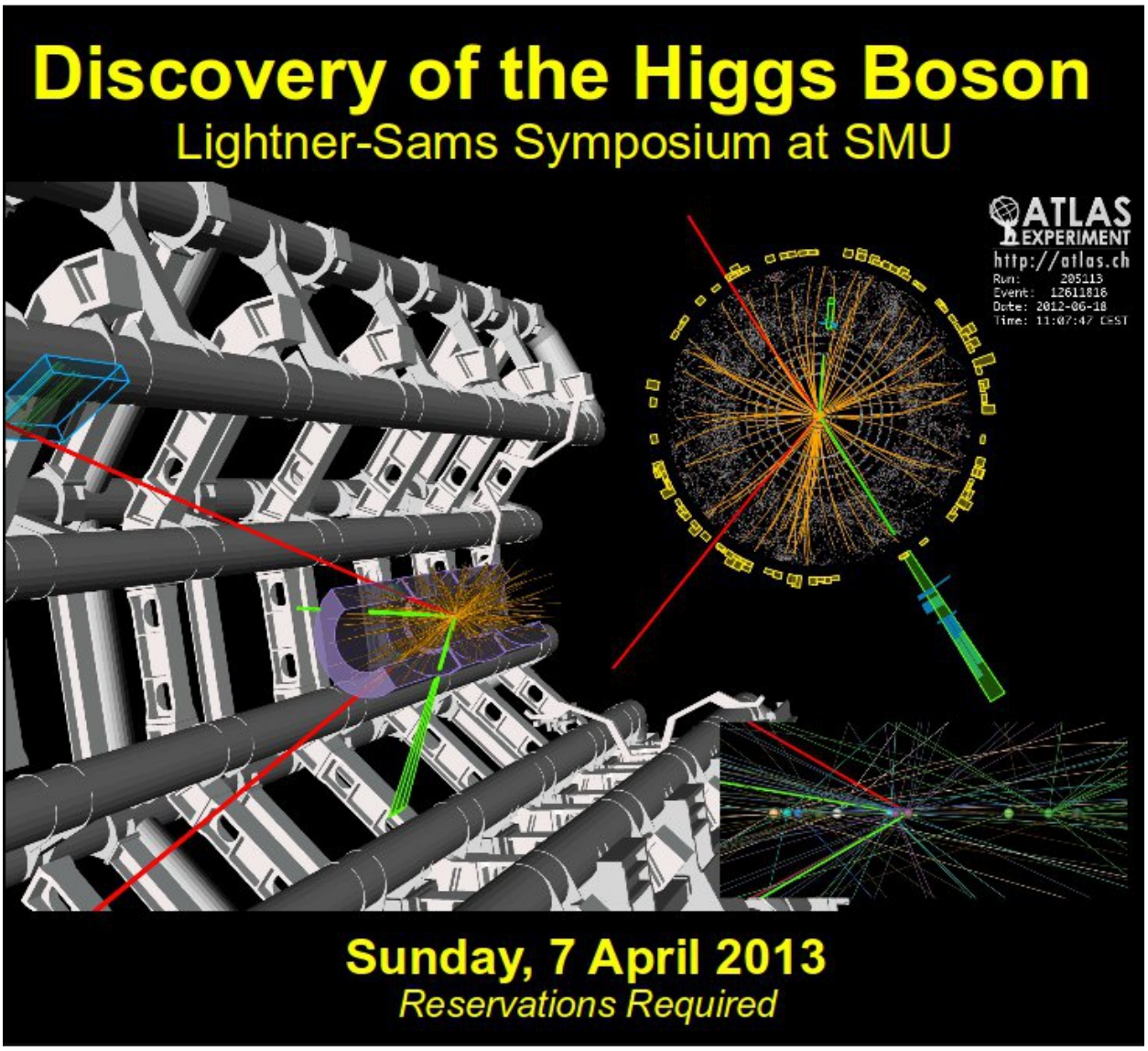
As part of the SMU's Centennial Celebration, Professor **Stephen Sekula** interviewed Emerti Professors **Jeff Chalk** and **George Crawford**, as well as **Robert Hyer Thomas** (President Hyer's grandson) to collect a video history of Physics at SMU. Excerpts will be released as part of the ***Mustang Physics Podcasts*** project.

The Department is pleased to announce that graduate students **Huanzhao Liu** and **Hang Qiu** have received the **Lightner-Sams Fellowship Award**, and **Bowen Wang** has received the **Tittle Award** to support their research.

Additionally the Department awarded the **Wiley Scholarship** to **Holly Howard**, and the **Chalk Scholarship** to **Joshua Abramovitch**.

Finally, many activities in the Department would not be possible without the generous support of our friends and alumni. On behalf of our faculty, staff and students, we express our thanks.

Fredrick Olness
Professor & Chair,
Dedman Family Distinguished Professor



The discovery of the Higgs Boson was selected as the 2012 "Breakthrough of the Year" by Science Magazine. The discovery, by the Large Hadron Collider (LHC) which was announced at CERN on July 4, 2013, comes nearly 50 years after the initial theory.

We will celebrate this momentous achievement, and the program will feature comments and personal stories by some of the Physicists who made this discovery possible.

Be sure to save the date, and please contact the Physics Department Office to reserve space at this event.

Higgs Boson Symposium

Sunday, 7 April 2013

Time: 6:00pm Reception
6:30pm Banquet

Reservations Required

Contact the Physics Department for details

shirley@physics.smu.edu

(214) 768-2495

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Physics Professor Jodi Cooley wins 2012 NSF Career Award

By Kathleen Tibbetts
March 7, 2012

Professor Jodi Cooley of SMU's Dedman College of Humanities and Sciences has earned a National Science Foundation CAREER Award of more than $1 million for her research toward detecting the particles that are believed to make up dark matter.

NSF Early Career Development Awards are given to junior faculty members who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research in American colleges and universities.

Cooley, an assistant professor in the Department of Physics, is an experimental particle physicist working with the Cryogenic Dark Matter Search (SuperCDMS), a collaboration of 14 institutions from the United States and Canada. Cooley is SMU's principal investigator for the group.

Scientists theorize that more than 80 percent of all matter in the universe is dark matter, which consists of material that cannot be seen or detected by conventional means. Cooley's research in the SuperCDMS project is conducted in the Soudan Iron Mine in Soudan, Minnesota, where researchers are shielded from cosmic-ray radiation as they use detector technology to "listen" for the passage of dark matter through the earth. Cooley's research uses sophisticated equipment to optimize the chances of detecting "weakly interacting massive particles," also known as WIMPS, which are the particles hypothesized to make up dark matter.

"Her CAREER Award will enable Professor Cooley to extend this research with additional measurements at higher levels of sensitivity and simulations, placing SMU in a leadership role in this cutting-edge field of physics," said James Quick, associate vice president for research and dean of graduate studies.

Cooley joined SMU in 2009. She was a postdoctoral scholar in the Physics Department at Stanford University from 2004-09 and a postdoctoral associate in the Laboratory for Nuclear Science at MIT from 2003-04. She received her Ph.D. in physics from the University of Wisconsin-Madison in 2003, a Master of Arts in physics from the University of Wisconsin-Madison in 2000, and a Bachelor of Science in applied math and physics from the University of Wisconsin-Milwaukee in 1997.

The NSF is the funding source for approximately 20 percent of all federally supported basic research conducted by America's colleges and universities. In the past few decades, NSF-funded researchers have won more than 180 Nobel Prizes.

Cooley is SMU's second NSF CAREER award winner this year. Joe Camp, J. Lindsay Embrey Trustee Assistant Professor of Electrical Engineering, received a Faculty Early Career Development Award for his research into improved wireless network design incorporating low frequencies.

Bob Kehoe named SMU Director of Undergraduate Research

By Kathleen Tibbetts
October 9, 2012

Associate Professor Robert Kehoe, coordinator of SMU's Undergraduate Research Assistantships program and director of undergraduate research in the Department of Physics, has been named the University's new Director of Undergraduate Research. He reports to James Quick, Associate Vice President for Research.

Kehoe sums up undergraduate research as "one of the single most promising recent developments to enhance student learning and prepare them for their ultimate career or vocation. It propels students out of the classroom to confront new questions and opportunities armed with the knowledge they have newly gained," he says. "It does this while students are still supported by the SMU community. Undergraduate research provides a valuable intermediate space between classroom curriculum and professional possibilities."

An SMU professor since 2004, Kehoe received his B.A. degree in physics from Earlham College and his Ph.D. degree in high-energy physics from the University of Notre Dame. He completed postdoctoral study in astrophysics and high-energy physics at the University of Michigan and Michigan State University, respectively.

Kehoe is a member of the SMU team on the ATLAS Experiment, the largest detector in the Large Hadron Collider array at the European Organization for Nuclear Research (CERN) in Geneva, Switzerland. His longstanding research into subatomic particle mass played a role in the search for the long-sought Higgs boson. He also contributed directly to the analysis published in summer 2012 that observed a new particle consistent with the Higgs.

His Higgs research focused on controlling and quantifying the large amount of background created in the production of two very massive charged particles used to help detect the previously unknown Higgs boson, as well as on understanding the large theoretical uncertainties involved in the production of those particles.

As a collaborator in Fermilab's DZero experiment, Kehoe led analysis of data from particle collisions resulting in two leptons, which helped improve measurements of the mass of another heavy subatomic particle called the top quark. Physicists theorize that this particle — because of its sizable mass — is sensitive to the Higgs and therefore may point to it, and that knowing the mass of the top quark narrowed the range of where the Higgs can be expected.

"Professor Kehoe knows good research and good research opportunities when he sees them," Quick remarked during the announcement of Kehoe's new duties at the University's 2012 Engaged Learning Expo on Aug. 27. Kehoe will continue to teach and do research in the Department of Physics.

Kehoe says his new position gives him "a well-defined role and a well-defined way to communicate with people. Now we can have a discussion about undergraduate research that will involve all of SMU." His primary goal will be to expand and help enrich research opportunities and experiences for SMU undergraduates, he says.

Cooperation among programs and consistent communications to students and parents "are hard to do by individual project coordinators in a way that benefits everyone," Kehoe adds. An office dedicated to building those connections "opens a whole new avenue for collaboration."

In addition, Kehoe will help to implement assessment for program effectiveness, as well as integration with the research component of SMU's Engaged Learning initiative.

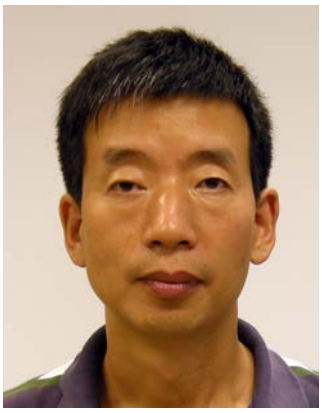
Kehoe has already started informal discussions with faculty and will consult with the coordinators of undergraduate research programs across campus. His main focus will be to help existing programs and help develop new ones, he says.

"We'll take a look at the programs we already have so we can discuss what's missing," as well as learning about faculty ideas for new programs, he says. He intends to establish a group to create a strategic plan for undergraduate research "with the input of a broad cross-section of SMU," including faculty, students and program coordinators.

"My job is not to tell program coordinators what to do," he says. "My job is to help them produce and coordinate common resources and practices, as well as to disseminate information that will enhance recruitment and retention."

To this end, Kehoe will direct an expansion of SMU's online undergraduate research presence, including a new website and the production of an online undergraduate research journal. He will also help create marketing campaigns and other communications for current and prospective students and faculty members.

Professor Annie C. Xiang, Research Assistant Professor in Physics has received a 3-year U.S. Department of Energy (DOE) R&D award (2012 to 2015) with a total funding of $200K to develop small-form-factor, high-reliability optical transmitters at the 120 Gbps range for high-bandwidth data transmission in future particle physics experiments. At SMU, she also leads the Versatile Link project, a collaboration with the European Organization for Nuclear Research (CERN), Fermi National Accelerator Laboratory and Oxford University, funded through U.S. ATLAS.



Professor Andy T. Liu, Research Associate Professor in Physics, has received an external research fund for two years (2013-2014) of a total of $150K, subcontracted from Ridgetop Group, Inc. through a Small Business Innovation Research (SBIR) phase-2 award from the U.S. Department of Energy (DOE). In this research Andy will conduct precision tests of an integrated circuit chip and an analog-to-digital converter (ADC). This low-power ADC is being developed for particle detectors.

News from the Opto-electronics Laboratory

Since 2004 there have been R&D projects in the Optoelectronics Lab for the ATLAS experiment's upgrade, in particular for the phase-1 upgrade of the level-1 triggering system of the Liquid Argon Calorimeter in ATLAS. A level-1 trigger system in a particle physics experiment is hardware based and performs selections of interesting events for physicists to analyze "off-line". Time allocated for a decision in the selection is usually a few microseconds; hence ultra fast electronics circuits are employed.

Three years ago research scientists in the lab set a world record of Application Specific Integrated Circuit (ASIC), a serializer, developed for a serial data transmission at 5 Giga-bit-per-second (Gbps) in particle physics experiments. At the end of 2012, the same group at SMU successfully tested their laser diode driver circuit at its design speed of 8 Gbps, and set a new record in the field. This laser diode driver was designed by **Mr. Futian Liang**, when he was a visiting scholar in the Optoelectronics lab. Futian is a Ph.D. student at the University of Science and Technology of China.

During his visit Futian was supervised by **Research Assistant Professor Datao Gong**. Research results from this development were reported at international conferences such as the TWEPP2012 in Oxford UK. Because of this very successful collaboration with USTC, we now have several visiting scholars from China working and learning in lab. They all contribute to the research projects that are leading us to a new construction period for ATLAS, bringing millions of research funds to the lab.

Dr. Alonso Gutierrez receives 2012 Emerging Leader Award

SMU Undergraduate Physics Alumnus **Dr. Alonso Gutierrez** received the 2012 Emerging Leader Award. The Emerging Leader Award recognizes an outstanding SMU alumnus or alumna who has graduated within the last fifteen years.

Alonso N. Gutiérrez '03 achieved a distinguished career in medical research, clinical service and teaching. He holds dual positions at University of Texas Health Science Center at San Antonio as assistant professor and as educational director of the Medical Dosimetry Program in the Department of Radiation Oncology. Gutiérrez earned B.S. degrees summa cum laude in both mechanical engineering and physics from SMU in 2003. While at SMU, he was a President's Scholar, Barry M. Goldwater Scholar and Frank C. McDonald Physics Scholar. He was honored with the Robert S. Hyer Award in Physics. He earned Master's and Ph.D. degrees in medical physics from the University of Wisconsin-Madison.

Gutiérrez joined the faculty of UT Health Science Center at San Antonio in 2007. He was on campus in February 2012 to present a talk on Medicine and Physics which was featured in the below article.

Talk Combines Medicine and Physics

By Parminder Deo (pdeo@smu.edu)
SMU DAILY CAMPUS, Sunday, February 26, 2012
Reprinted with permission.

Medicine and physics make a connection. Alpha Epsilon Delta (AED), SMU's Health Pre-professional Honor Society, and the physics department presented guest speaker **Dr. Alonso Gutierrez** on Friday. The lecture highlighted the increasing use of image-guided, stereotactic radiotherapy techniques in cancer treatment.

An SMU graduate, Dr. Gutierrez works as an assistant professor in the department of radiation oncology at the University of Texas Health Science Center at San Antonio.

"It is astonishing to see that you can treat cancer, something you can't see, with something you still can't see and it goes away," Dr. Gutierrez said.

In today's world of medicine, the physicists actually play the roles in assessing and making sure the machines for cancer therapy are highly accurate and provide precision modeling. Medical physicists work to characterize the radiation and standardize an accurate dose calibration for patients.

Tumor cells are not efficient in repairing themselves as normal cells. This flaw in the tumor cell is what doctors use to their advantage when it comes to cancer therapy. By fractionating the amount of radiation delivered to a patient, you allow time for the normal cells to repair while the cancerous cells are slowly being treated and degenerated.

"Everything in life is related to physics in one way or another. A lot of it is having to get over the initial hesitation that physics is a challenge for students. It is different — it isn't like biology — but I think pre-med students gain a lot from it," Gutierrez said.

The joint venture between AED and the physics department was designed to show pre-medical students

Professor Alonso Gutierrez

that there is a field that combines both physics and medicine and the application of the two can make a difference.

"We knew that many pre-med students think that physics is not relevant to their career, and we thought that this [lecture] would be a nice way to bridge the gap between medicine and physics. To also show that there is an actual junction and there are a broad range of careers with a physics degree," **Physics Professor Jodi Cooley** said.

Medical physics has become a fast-evolving field, primarily attributed to technology. The skill set necessary has also diversified with the increasing study of molecular biology to physics interactions with radiation. Due to the fast nature and adaption of new technologies provides numerous opportunities for research and development.

"When you can see the application of physics and biology, it is fascinating because physics is underneath it all. You can answer the questions of why things act a certain way," junior Holly Howard said.

An educational journey that began with reading by candlelight

Santosh Adhikari

December 19, 2012
By Nancy George

When **Santosh Adhikari** graduated from SMU on Dec. 15 with Bachelor's degrees in physics and mathematics, he celebrated a journey that began with reading physics books by candlelight in his village of Kusunde, Nepal.

The son of a math teacher, Adhikari grew up in a village in northern Nepal only accessible by foot. When he swam in the nearby river, he wondered why rocks were lighter underwater than they were outside of the water. To satisfy his curiosity, he asked his father to bring him books about great scientists when he traveled to the nearest city. Adhikari's village had no electricity, so he read the books about Albert Einstein and Sir Isaac Newton by candlelight.

His parents sent him at age 14 to high school in Nepal's capital, Kathmandu, an eight-hour walk. He rented a room, prepared his own meals and lived on his own while he attended high school, visiting his village just once a year.

Family in Dallas drew him to Texas where he attended community college, then earned one of SMU's 10 full-tuition community college transfer scholarships. As an undergraduate at SMU, Adhikari published research in a scientific journal about the most sophisticated science experiment in the world, the CERN particle collider. He and SMU physics Professors Simon Dalley & Pavel

Santosh Adhikari with Profs. Cooley and Olness at 2012 Honors Convocation

Nadolsky studied data for new evidence of the "God particle," or Higgs boson particle. He plans to pursue a Master's degree, then Ph. D. in physics, with long range plans to open a research laboratory in Nepal.

In addition to a diploma, SMU's Department of Physics traditionally presents its graduates with a book about physics. Adhikari's physics library now includes another book about a great scientist, the three-volume physics classic, The Feynman Lectures on Physics (Basic Books, 1964), written by Nobel Prize-winning physicist Richard Feynman.

SMU Presents AAPT Award To Outstanding Physics TA's

19 April 2012: **Benjamin Clark** and **Matthew Rispoli** have been named The American Association of Physics Teachers (AAPT) Outstanding Physics Teaching Assistants at Southern Methodist University.

Clark, a second-year graduate student from San Antonio, Texas, and Rispoli, a senior majoring in Physics and Mechanical Engineering from Brownsville, TX, are majors in SMU's Department of Physics. Both will receive a certificate of achievement and a gift membership to the AAPT.

Matthew Rispoli

Rispoli taught in classes led by Assistant Professor Dr. Jodi Cooley. Clark assisted in classes led by Dr. Jodi Cooley and Dr. Randy Scalise. "Matthew Rispoli has been an outstanding teaching assistant this past year," Cooley said. "Matthew was a great role model for the other students. At the end of the year several of the students came to my office to tell me that they thought Matthew was the best TA they ever had. In addition, I could always count on Matthew to perform his duties. Often he held review sessions for the exams, which were not required as part of his job description." During the fall semester, Rispoli assisted with Introductory Mechanics, a course taken primarily by freshman and sophomore engineering students. This spring, he assisted an Advanced Laboratory course whose students are typically physics majors in their junior year. "Students in both sections spoke very highly of Rispoli's teaching abilities," said Fredrick Olness, SMU physics professor and department chair. "He continues to perform his duties exceptionally."

Clark has been a teaching assistant for "Music & Physics" and "Ideas of Modern Physics" courses. "His performance in these courses has been superb," Olness said. Clark is studying Deep Inelastic Scattering (DIS) of leptons from heavy targets, which are used extensively to constrain Standard Model (SM) parameters and determine the nucleon structure functions. He is specifically developing a Mathematica interface to the Parton Distribution Functions (PDFs) to facilitate calculations, comparisons and data analysis.

Beal Bank Dallas Regional Science & Engineering Fair

Led by **Professor Simon Dalley**, faculty and staff of the SMU Physics Department organized the 2012 Beal Bank Dallas Regional Science & Engineering Fair (DRSEF). Over 1,000 middle and high school students and 400 judges registered from the Dallas area, an increase of 40% over the last 5 years, reversing a trend (reflected nationally) of declining science fair participation. They gathered at Fair Park on February 25 to exhibit and compete for $100,000 in prizes. Competition winners, together with their parents and teachers, were later hosted on SMU campus at an awards banquet. Over 400 people attended in Hughes-Trigg student center, where they were addressed by Dean of Dedman College **William Tsutsui, Carl Dorvil,** CEO of Dallas-based Group Excellence—one of the 500 fastest-growing private companies in the country—and **Daisuke Takeda**, SMU Class of 2015 and DRSEF Grand Prize runner-up.

Over 100 students who placed in their science category at the DRSEF went on to the Texas state science fair, creaming the opposition by winning 40% of all prizes there, while 8 students won awards at the International Science Fair, four of whom placed 2nd in their science categories.

Ben Clark interviews one of the DRSEF entrants on fair day.

Physics Students Receive Awards at 2012 Honors Convocation

2012 Honors Convocation. (Front L-R) Holly Howard, Mayisha Nakib, Santosh Adhikari, Matthew Rispoli, (Back) Profs. Jodi Cooley, Fred Olness, Joshua Abramovitch, Richard Guarino, Jason South, Dennis Stanley.

The Physics Department's Undergraduates have been very busy in a wide range of interesting research in the past year. Several students received awards at the recent SMU Honors Convocation.

Physics award winners include: **Holly Howard** (Wiley Scholarship), **Joshua Abramovitch** (Chalk Scholarship), **Matthew Rispoli** (Hyer Award), **Landon Banister** and **Dennis Stanley** (McDonald Award), and Hamilton Scholars include **Keith Adler**, **Matthew Bruemmer** and **Ben Wise**.

One of our former Hamilton Scholars, **Landon Banister**, has been award the 2012 Robert Hyer Award by the Texas chapter of the American Physical Society (APS). The APS is the largest professional membership society in American physics and hands this award out once per year. Landon was able to pursue research into the connection between normal matter and dark matter, which is observed to make up 85% of the matter in the universe but whose composition is unknown. His work is currently being reviewed by the experiment that provided the data, and will be submitted for publication soon.

Santosh Adhikari studied Drell-Yan like boson resonances and generalized angular asymmetry to optimize spin identification when only a limited sample of events is available by choosing simple weight functions for polar and azimuthal angle. He was supported by URA in summer 2012, he presented at the 2012 Fall APS Texas meeting in Lubbock, and he received a Hamilton Research Scholar in Fall 2012.

Several other students have pursued research in the last year, ranging from projects in testing of optical fibers for the high radiation environment of an upgraded LHC, to several data analysis projects.

Faculty Mentor Young Researchers In Their Quest For Knowledge

Mayisha Nakib (right) with Professor Jodi Cooley.

Posted on May 29, 2012 by SMU Magazine

First-year student Mayisha Nakib had been at SMU only a week last fall when she achieved one of her goals: to participate in research as an undergraduate. Upon learning of Nakib's interest, Assistant Professor of Physics Jodi Cooley suggested that she apply for a Hamilton Scholars Undergraduate Research grant. Nakib, a Dedman College Scholar, received the grant and now works with Cooley on dark matter research in the clean-room laboratory in Fondren Science Building.

Mayisha Nakib

Nakib is one of nearly 130 undergraduates who are conducting research with faculty across the University, from anthropology to engineering to statistics. Many are supported by SMU's Undergraduate Research Assistantship program, created in 2005 to provide funds to encourage undergraduate research.

Physicist Jodi Cooley leads SMU students as part of a global team searching for elusive dark matter – the "glue" that represents 85 percent of the matter in our universe, but which has never been observed. Cooley is a member of the scientific consortium called SuperCryogenic Dark Matter Search (SuperCDMS), which operates a particle detector located deep in an underground abandoned mine in Minnesota. The detector is focused on detecting WIMPS (Weakly Interacting Massive Particles), which some physicists theorize comprise dark matter. WIMPS are particles of such low mass that they rarely interact with ordinary matter, making them extremely difficult to detect.

To assess background interference that could affect their research, Cooley and her team rely on the high-tech XIA Alpha Particle Counter, housed in a clean-room operated by the Department of Physics. SMU is one of only five institutions in the world to house the XIA. As part of the team, student Mayisha Nakib is investigating the history of various detectors to calculate their exposure to radon or radioactivity, which can produce background interference. Less background interference improves the chances of observing WIMPS.

Nakib, who is majoring in biological sciences and physics, says she already has learned new computer skills and how to operate the particle counter. "The faster I get involved with research, the easier it will be to pick it up."

Cooley adds that the Physics Department has more students who are eager to conduct research than it has faculty who can mentor them.

Mayisha Zeb Nakib attended Ruston High School in Ruston, Louisiana and intends to double major in Biochemistry and Physics, and minor in Music. In addition to her extremely high academic credentials Mayisha was very involved in high school: winner of First Place in Mathematics; First Overall Winner of the Regional Science Fair.

Describing herself as a "Why Child," Mayisha remembers carrying around a set of binoculars and a telescope. Mayisha made her final decision between Tulane University and SMU—it was the scholarship and academic opportunities, the engaging small classes, and the emphasis on undergraduate research that ultimately led her to the Hilltop.

Society of Physics Students (ΣΠΣ) News

SPS Students Organize Holiday Toy Drive

Collected toys from the SPS Toy Drive

Over the past two years, the Society of Physics Students have been involved in providing support for the Bryant Joseph Christmas in the Community toy drive. This event provides families in underprivileged neighborhoods of Dallas with gifts for the winter holidays. Holly Howard '12 began the Society of Physics Students' involvement with Christmas in the Community in 2011 through her contact with Rev. Ronald Wright, who leads the program. SPS's involvement was to organize the collection of toys from SMU and delivery of gifts to the event. This organized effort did not only collect toys internally from the Physics Department, but was able to arrange for a great and generous partnership with the Biology Department, Engineering School, and student center at SMU. SPS's involvement allowed a great number of people at SMU to be able to help cheer up the holiday season for others. Donors specifically appreciated the ability to give to a local charity where no portion of the gift went to waste.

This year's involvement with the toy drive has been equally exciting and successful! SMU physics undergraduate Mayisha Zeb Nakib was in charge of organizing the toy drive this year. SPS again organized toy donation locations around campus, their advertisement, their collection and delivery to the event. The large amount of support received for the 5th annual Bryant Joseph Christmas in the Community culminated in providing more than 400 local families with toys for the winter holidays. Thanks to Holly's and Mayisha's hard work, and the generosity from the entire SMU community, SPS was able to organize a school wide effort into providing others with a joyful holiday season.

SPS Students plan trip to McDonald Observatory and Trinity Site

The SMU Physics SPS Chapter is organizing a field-trip to visit the Trinity Test Site in New Mexico where the first atomic bomb was detonated. This site is now a National Historic Landmark, and it is only open two days per year.

The group will also visit the McDonald Observatory located in west Texas near Ft. Davis. This observatory is home to a number of telescopes including the Robotic Optical Transient Search Experiment (*ROTSE*) which is now operated by SMU Physics.

SMU Initiates Master Physics Teacher Certificate Program

The Master Physics Teacher Certificate Program (MPTC) participants in the laboratory.

Physics is the fundamental science at the root all the sciences and the precursor to all modern technology. The United States and other developed countries have a shortage of qualified physicists, traditionally relying on foreign scientists to fill positions. With the growing importance of STEM disciplines and the increased Texas State Math and Science requirements for High School graduation, it is a challenge to recruit and train talented science and math teachers.

Texas does not require a minimum number of college credits in physics to be qualified to teach high school physics. Nationally, about 2/3 of high school physics teachers do not hold a major in physics or physics education; half do not hold a minor. Attempts over the years to train more physics graduate teachers have not significantly impacted the shortage; physics majors can earn much higher salaries elsewhere and typically do not remain teachers for long.

This SMU Physics MPTC initiative seeks to break the cycle by addressing the problem in a relatively unexplored way by systematically strengthening the physics content of existing career science teachers who are teaching out of subject. They are brought into contact with experienced physicists who strengthen their physics background, giving them ideas, sources and materials that they can use in their classrooms.

This will be done via team-taught courses in the SMU Physics Department. The department has been running a pilot program in the 2012-13 academic year for 20 teachers. This project is jointly supported by **Dedman College** and the **Simmons School of Education & Human Development**. The curriculum draws from successful elements of introductory physics courses and from the existing SMU Physics QuarkNet summer workshop program for physics teachers.

The MPTC program differs from traditional professional development offerings. It is much more physics-content-focused, sustained, systematic, and modern in content. Given that the participants are currently career teachers, the efficiency of the program for producing better teachers who will serve in our schools is a guaranteed 100%.

SMU Lead Faculty:

Simon Dalley
Farley Ferrante
Randall Scalise
Dara Williams-Rossi

SMU Physics QuarkNet Program for HS Science Teachers

2012 SMU Physics QuarkNet participants.

The SMU Physics Department sponsored its annual QuarkNet Workshop for local high school physics teachers the week of August 6-10, 2012, an event which it has organized annually since 2001. This year's workshop had 14 teachers from Dallas area public and private schools.

The LIGO Detector

The main workshop theme was gravitational wave interferometry. In preparation for this year's workshop, QuarkNet teachers were invited in the spring to the 2012 Lightner-Sams dinner and lecture at SMU, given by Prof. Craig Hogan (Fermilab) on the subject of gravitational waves and their detection.

At the summer workshop, teachers each successfully built their own simple make-and-take interferometers in the lab. There were a variety of supporting lectures from SMU faculty and the school teachers themselves.

The LIGO Detector

Dale Ingram, from the Laser Interferometer Gravitational-wave Observatory (LIGO), joined the workshop via video-link and spent an afternoon describing the facilities and the LIGO-eLab, which contains seismic data that can be used as a school project resource. At the end of the workshop week, most of the teachers traveled to LIGO in Livingston LA, where they were conducted on a guided tour inside and outside the 16 square kilometer experiment.

The QuarkNet program is funded by the National Science Foundation.

http://www.physics.smu.edu/scalise/quarknet
Faculty Mentors: Simon Dalley, Randy Scalise

SMU Physicists at CERN Discover Long Sought After Higgs boson

By Margaret Allen
July 4, 2012

In a giant game of hide and seek, physicists announce discovery of the long sought after fundamental particle called the Higgs boson.

Researchers at Switzerland-based CERN, the largest high-energy physics experiment in the world, have been seeking the Higgs boson since it was theorized in the 1960s. The so-called "God" particle is believed to play a fundamental role in solving the important mystery of why matter has mass.

Thousands of scientists from around the world participated in the discovery of the Higgs particle through experiments at CERN's Large Hadron Collider. The researchers analyzed a flood of electronic data streaming from the breakup of speeding protons colliding in the massive particle accelerator.

Physicist and SMU Professor Ryszard Stroynowski answers questions from SMU students, faculty and the public who viewed a web cast of CERN's press conference in Geneva on Tuesday. (Credit: Hillsman Jackson)

The discovery was announced on July 4, 2012 in a seminar held at CERN. "This is a very big step in the understanding of particle physics," said Southern Methodist University physicist **Ryszard Stroynowski**, the leader of SMU's team of scientists working on the experiment.

Higgs: The missing piece of the Standard Model

Theorists have predicted that some subatomic particles gain mass by interacting with other particles called Higgs bosons. The Higgs boson is the only undiscovered part of the Standard Model of physics, which describes the basic building blocks of matter and their interactions.

Higgs bosons, if they exist, are short-lived and can decay in many different ways. Just as a vending machine might return the same amount of change using different combinations of coins, the Higgs can decay into different combinations of particles. Discovery relies on observing statistically significant excesses of the particles into which they decay rather than observing the Higgs itself.

SMU researchers contributed to the discovery:

Besides Stroynowski, the SMU team of researchers includes three other Physics Department faculty: **Jingbo Ye, Robert Kehoe** and **Stephen Sekula**, six postdoctoral fellows and five graduate students. Main contributions to the new analysis of the data were made by postdoctoral researcher Julia Hoffman and graduate student **Ryan Rios**. Others in the department who have contributed include former postdoctoral fellow **David Joffe**, now an assistant professor at Kennesaw State University, graduate students **Renat Ishmukhametov** and **Rozmin Daya** and theoretical faculty **Fredrick Olness** and **Pavel Nadolsky**.

"Professor Stroynowski has demonstrated extraordinary scientific leadership in keeping our relatively small Department of Physics at SMU engaged in one of the most significant scientific experiments of our time," said Jim Quick, SMU Associate Vice President for Research.

SMU's role in the LHC experiments provides SMU students a chance to participate in pioneering discoveries, said Olness. "SMU students helped build the ATLAS detector, they were in the control room when the experiment started up, and they contributed to the analysis," he said. "The results presented today are historic, and they will help shape our view of the matter and forces that comprise our universe; SMU students have played a role in this achievement."

Higgs discovery confirms decades-old theory:

Discovering the type of Higgs boson predicted in the Standard Model confirms a theory first put forward in the 1960s. "This year, the LHC has come roaring into the front of the hunt for the Higgs boson," said Robert Kehoe, Associate Professor in

the SMU Department of Physics. "With the discovery of the Higgs Boson, we now know for sure the mechanism breaking the symmetry between electromagnetic and weak interactions. We have discovered a truly new thing.'"

Even with the measurements from the LHC experiments, it will take more analysis and more data to prove it is a Standard Model Higgs, according to CERN researchers. If scientists found subtle departures from the Standard Model in the particle's behavior, this would point to the presence of new physics, linked to theories that go beyond the Standard Model. Observing a non-Standard Model Higgs, currently beyond the reach of the LHC experiments with the data they've recorded so far, would immediately open the door to new physics, said an official statement from CERN.

Results constrain Higgs' mass

In announcing the findings, CERN noted that two experiments at the LHC have nearly eliminated the space in which the Higgs boson could dwell. The ATLAS and CMS experiments see modest excesses in their data that could soon uncover the famous missing piece of the physics puzzle, the scientists said.

The experiments' main conclusion is that the newly discovered Higgs boson is has a mass of approximately 126 giga-electron-volts (GeV), and this is observed by both the ATLAS and CMS experiments.

Both ATLAS and CMS have analyzed several decay channels, and the initial results are generally consistent with the Standard Model Higgs Boson, although more precise investigations are currently in progress. These new questions are generating a lot of interest in the particle physics community.

Experiments continue to refine the analysis

More than 1,600 scientists, students, engineers and technicians from more than 90 U.S. universities and five U.S. national laboratories take part in the ATLAS and CMS experiments. The Department of Energy's Office of Science and the National Science Foundation provide support for U.S. participation in these experiments.

Over the coming months, both the ATLAS and CMS experiments will focus on refining their analyses in time for the upcoming particle physics conferences. Should this newly discovered Higgs Boson prove to be different than the Standard Model Higgs, this would point to new physics yet to be discovered at the LHC's full design energy, set to be achieved after 2014. Whether ATLAS and CMS show over the coming months that this is a Standard Model Higgs boson or not, the LHC program is closing in on new discoveries.

Professor Ryszard Stroynowski and physics graduate student Ryan Rios discuss the Higgs boson. (Credit: Hillsman Jackson)

SMU is a member of the ATLAS experiment at the LHC. It takes a large team of scientists to search for the Higgs and other new physics; the SMU delegation includes faculty members Ryszard Stroynowski, Jingbo Ye, Robert Kehoe, Stephen Sekula, and a number of research professors, postdoctoral fellows and graduate students.

In addition, recent SMU ATLAS contributors include postdoctoral fellows Julia Hoffman, David Joffe (now at Kennesaw State), Ana Firan, Haleh Hadavand, Sami Kama, Aidan Randle-Conde and Peter Renkel, and graduate students Ryan Rios, Rozmin Daya, Renat Ishmukhametov Tingting Cao and Kamile Dindar-Yagci. Theoretical support was provided by faculty member Pavel Nadolsky, electronics development by research professors Andy Liu and Annie Xiang, and computer support by Justin Ross.

The Quest for the Higgs Boson

"It doesn't matter how beautiful your theory is, it doesn't matter how smart you are. If it doesn't agree with experiment, it's wrong." — Physicist Richard Feynman

By Fredrick Olness

A 50 year search for the origin of particle mass nears an end. Maybe.

Mass is a seemingly simple property of everyday objects — atoms, humans, coffee cups. Yet, to understand the origin of mass on a fundamental level has been a challenging problem with a long history. The solution to this problem, suggested nearly 50 years ago, was the Higgs Boson (or just Higgs, for short). However, it remained to be discovered.

On Wednesday, July 4, 2012, an end to the Higgs search was achieved when the CERN Laboratory in Geneva, Switzerland announced the discovery of the Higgs Boson at the Large Hadron Collider (LHC) in a colloquium broadcast around the globe on the World Wide Web.

The announcement was a joint presentation by researchers from ATLAS and CMS, the two largest independent experiments at the LHC, in which they presented evidence for the Higgs based on the results of their 2012 data set.

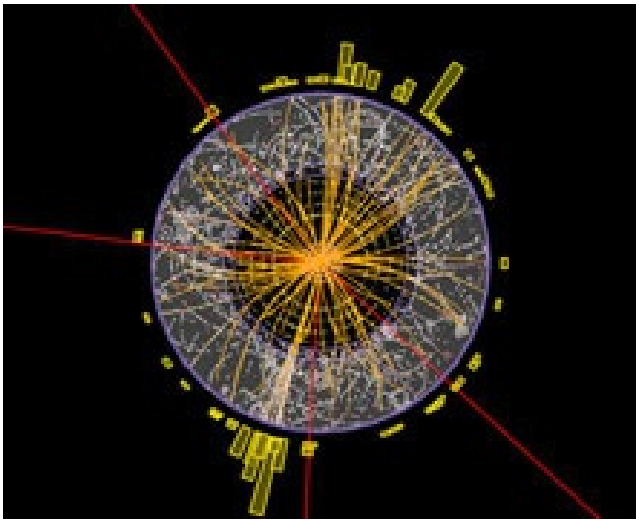
Both the ATLAS and CMS experiments observed evidence for the Higgs, and these two independent analyses find a mass range for the Higgs which is consistent.

These results represent a tremendous step forward in explaining why fundamental particles have mass, and whether the Higgs exists.

What is the Higgs boson?

The postulated Higgs boson is responsible for giving mass to the many fundamental particles that make up the universe. This includes the quarks that comprise protons and neutrons, which comprise atoms and molecules, which comprise humans and everything around them. In essence, the Higgs generates the mass of the fundamental particles that make up you and your coffee cup.

We know objects have mass — just lift a heavy suitcase or weigh yourself on a scale. But to explain this seemingly simple idea in the context of our current fundamental theories has been a struggle ever since the idea of the Higgs was introduced 50 year ago. The problem is that to give particles mass in a straightforward manner would spoil a particular symmetry of the theory known as the "gauge symmetry." Who cares? you ask, and why should I be worried about symmetry?



An event showing four muons (red tracks) from a proton-proton collision in ATLAS. This event is consistent with two Z particles decaying into two muons each. Such events are produced by Standard Model processes without Higgs particles. They are also a possible signature for Higgs particle production, but many events must be analyzed together in order to tell if there is a Higgs signal. (Credit: CERN)

Symmetries have been an important guiding aspect of physics dating back before Einstein, who used symmetry principles, in part, to conclude that "all reference frames are created equal," which led to his Theory of Relativity — certainly one of the triumphs of the 20th Century.

And that is what is so special about the Higgs; it gives particles a mass without violating the rules of symmetry.

How does the Higgs solve the problem?

According to our current understanding, Higgs bosons permeate all of space. As fundamental

particles move through space, Higgs bosons interact with the particles and effectively exert a drag on them; it is this drag effect which we interpret as the mass of the particle.

Consider the following experiment. First move your coffee cup through the air, and then repeat this motion underwater; the water provides more resistance on the cup and it "feels more massive" as you drag it through the water as compared to the air. It is the interaction between the water and the coffee cup that provides the resistance to motion of mass. In this analogy, the water is playing the role of the Higgs.

It is the same with a quark, one of the fundamental particles that matter is made from. As a quark moves through space it interacts with the Higgs, and this interaction exerts a drag on the quark so that it "feels heavy." But this is an illusion; in the strict interpretation of the theory, the quark has "mass" only because of the interaction with the Higgs that simulates the effects of the weight.

Déjà Vu: Luminiferous aether

To recap, the current theoretical picture is that Higgs bosons are everywhere. They permeate all space, and they must exist so that fundamental particles (that make up you and your coffee cup) have mass.

Have we seen this situation before?

In the late 1800′s, physicists posited the existence of a "luminiferous aether" which permeated all space. Scientists knew that water waves traveled through water, sound waves through air, and so they believed that light waves also needed something to travel through; luminiferous aether was invented to serve this purpose and get the "right" answer. There were many experiments that gave indirect evidence for the aether; however, all attempts to directly measure it were unsuccessful. Eventually it was demonstrated that the luminiferous aether did not exist, and this paved the way for Einstein to show that it was unnecessary and to present an alternative, his theory of relativity.

Thus, the non-existence of luminiferous aether actually led to more fantastic discoveries than if it had been proven.

Direct vs. indirect evidence

So we come to the central question: what does the existence of the Higgs imply?

Previously, there was ample indirect evidence that the Higgs exists. We know that fundamental particles have mass, and we believe this mass is due to particle interactions with Higgs bosons. Over the past 50 years physicists have performed a variety of sophisticated experiments, and they all point to the existence of the Higgs.

However, in many ways the Higgs is a contrived solution; inelegant, introduced into the theory because so far there has been no better way to get the right answer — that particles have mass.

Just because it is currently the only solution developed does not mean it is the one that nature chooses.

And that is why we needed direct evidence of the Higgs; we needed to produce an actual Higgs in the laboratory, study its properties, and verify our theoretical view of the world with cold, hard facts from experimental observation.

The 2012 LHC results

The LHC experiment is producing these facts and evidence.

Now that the Higgs is confirmed to exist, it validates our theory of how particles acquire mass, and serves as the foundation for myriad experiments in the future. Many speculate this discovery also warrants a Nobel Prize.

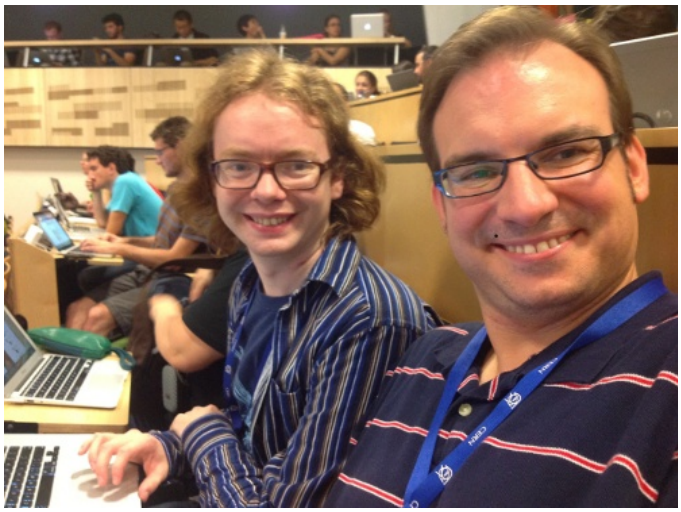
Is this the Standard Model Higgs?

If the Higgs is confirmed to be the "plain ordinary" Standard Model Higgs, that would be wonderful. If not, it would be even better as it would likely send many theorists back to the drawing board in hopes of finding that nature has an even more elaborate mechanism of how particles acquire mass than we have yet been capable of conceiving.

Either way it will be an exciting journey and the results from the LHC bring us one step closer to the answer.

The non-existence of the luminiferous aether led to Einstein's Relativity; what will the existence of the Higgs Boson lead to???

On the Ground with the Higgs Announcement



Aidan Randle-Conde (L), & Stephen Sekula (R)

By Stephen Sekula

Aidan and his mom arrived at my apartment at about 10:30 pm on July 3, 2012. In just about 10 hours, CERN was going to present the latest results from the ATLAS and CMS experiments in the search for the Higgs particle. These updates would have the right amount of data in them, the amount needed to know whether the hints of the previous winter would become strong signals . . . or fade away into the haze. When I arrived at the passenger door of Aidan's car, I heard him say, "Let's do this, Sekula!"

We had a plan. We were going to camp on the floor in front of the doors of the main CERN auditorium, where the pair of experimental seminars would be held. Aidan and his mom (who had flown from England solely to be part of this experience) has prepared bags of food and games. We were committed to being in that room when these presentations were made, and we suspected that we were not the only ones who had this plan.

We were right. When we arrived at the main auditorium, just around 11 pm, there were already about a dozen people in line ahead of us. We set up camp, made some coffee and started entertaining ourselves. More people arrived. In just a couple of hours, dozens of people had queued behind us along the inner wall of the auditorium foyer. They brought sleeping bags, pillows, movies, and games. The people next to us fell asleep after watching the movie "Ice Age," and a steady din of conversation continued through the night. People came by, not with the intention of camping, but to take photos of all these crazy folks camped out for the Higgs. The people camped in that space sampled across a huge part of the countries and cultures of the Earth.

By 5 am, the line of people was so long - along all the walls of the foyer and then down the stairs, past the bank, and off toward the big CERN cafeteria - we knew that people somewhere near the bottom of the stairs would not be getting into the auditorium. Even so, there was a sense of being part of this, even if not all of us were directly involved in the results to be shown that day. The commitment to being there was so strong that when a fire alarm went off just an hour before the doors opened to the auditorium . . . NOBODY MOVED.

We looked around. Nothing was on fire. Had somebody

The crowd before the lecture.

pulled it by accident? Some people speculated that someone at the back of the line pulled it to get rid of people at the front of the line. Eventually, CERN firefighters and security both swept the area and turned off the false alarm.

When the doors opened at 7am--still two hours before the start of the seminars--CERN security carefully but quickly sorted us into the auditorium. The front section of the room was designated for special guests, including Peter Higgs himself and members of the CERN governing body. People were excitedly chattering away, taking more photos, and getting settled for the presentations. We grabbed seats wherever they were not reserved, waiting for the talks to begin. We all now know the results of those seminars. As each speaker began, first CMS's Joseph Incandela and then ATLAS's Fabiola Gianotti, the room was silent and filled with heavy anticipation. That anticipation exploded into cheers and applause as one experiment, and then the other, showed that indeed the signals had gotten stronger and they had it . . . well, they had SOMETHING. It was something new, something heavy, and it was so-far consistent with the Higgs. In just a couple of hours, decades of waiting, working, planning, building, thinking, and finally studying the data exploded into feverous and furious applause whose sound I will never forget.

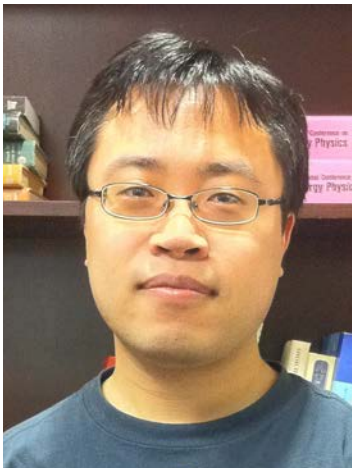
But was it the Higgs? Today, we are hard at work trying to answer that most fundamental question: what IS this new particle? It is still consistent with the Higgs particle, but the harder work now proceeds to truly understand this new particle. We have embarked on a new quest to illuminate the properties of this heaviest of bosons.

Lightner-Sams Graduate Fellowship Awards

For the past several years the Lightner-Sams Foundation has provided funds for Fellowships for outstanding graduate students in Physics. The 2012 recipients are Hang Qiu and Huanzhao Liu.

Hang Qiu in the laboratory.

Hang Qiu is working with Professor Cooley on the SuperCDMS Experiment which is searching for dark matter. The experiment is located in the Soudan Underground Laboratory in Minnesota and began taking data in 2010. Hang is currently analyzing data taken from the first run of the SuperCDMS experiment. In addition, he is working with others to design the next generation of this experiment which is planned to be located in SNOLAB, an underground laboratory in Sudbury, Canada.



Huanzhao Liu

Huanzhao Liu is working with Professor Robert Kehoe on the DØ experiment which studies events from the Tevatron proton-antiproton Collider at Fermilab in Batavia, Illinois, USA. The DØ experiment ran for 20 years, and finished data-taking in September 2011. Data from this experiment allows us to study the most elementary of nature's constituents.

William (Bill) Tittle Graduate Awards

This award is named in honor of former Physics Professor & Chair, William (Bill) Tittle, and it provides support for graduate students for travel to conferences and workshops. The 2012 recipient is **Bowen Wang**.

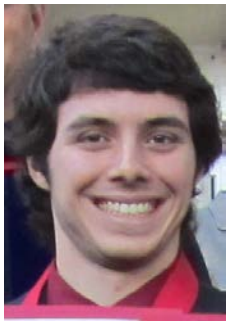
Bowen Wang is working with Professor Nadolsky on the phenomenology of parton interactions. Data from the LHC and Tevatron experiments are compared with the simulations from event generators to study the parton distribution functions provided by the CTEQ collaboration. Bowen is currently working on the analysis of the Pb-Pb collisions at the LHC.

Bowen Wang had the honor of meeting Mrs. Tittle at her 90th birthday party

The Wiley Scholarship

We are pleased to announce that **Holly Howard** is the 2012 recipient of the Wiley Scholarship. Holly conducted research with **Prof. Stephen Sekula**, graduated in 2012 with a Physics minor, and will be starting medical school this Fall.

The Chalk Scholarship



We are pleased to announce that **Joshua Abramovitch** is the 2012 recipient of the Chalk Scholarship. Joshua is working on research with **Prof. Kehoe**, and the scholarship will provide support for a conference trip to present his work.

SMU Physics Students Discover Supernovae

A long time ago, in a galaxy far, far away...

The light from a star that exploded in a galaxy in the Virgo Cluster around 230 million years ago was first observed by SMU graduate students **Farley Ferrante** and **Govinda Dhungana** on November 20, 2012. The observation was made using the 0.45-m (18") ROTSE-IIIb telescope located at McDonald Observatory in the Davis Mountains of west Texas. After photometric analysis indicated a probable supernova candidate, a spectrum was obtained by the 9.2-m Hobby-Eberly Telescope—also located at McDonald Observatory—which confirmed the object observed as a Type Ia supernova. The International Astronomical Union officially designated the discovery as SN 2012ha. ROTSE supernova discoveries are also given a nickname; this one is called "Sherpa."

Supernovae are extraordinarily bright stellar explosions that signal the death of a star. A Type Ia supernova is a sub-category of supernovae that results from the violent explosion of a white dwarf star. A white dwarf is the remnant of a star that has completed its normal life cycle and has ceased nuclear fusion. However, white dwarfs can accrete matter from companion stars in binary systems. Then upon reaching a certain mass, the white dwarf collapses, fusion reignites, and a catastrophic explosion ensues

Since Type Ia supernovae result from a common mechanism, they share a characteristic luminosity or brightness. By comparing the known intrinsic brightness of Type Ia supernova to their visual magnitude or observed brightness, the distance to the host galaxy can be computed. Thus Type Ia supernova can be used as "standard candles" to calibrate large-scale distances in the universe

The 2011 Nobel Prize in Physics was awarded to two research teams—one led by Saul Perlmutter who spoke at SMU in 2010—who used Type Ia supernovae to discover the accelerating expansion of the universe, presumably driven by a mysterious and unknown "dark energy."

Under the supervision of Associate Professor **Robert Kehoe**, primary responsibility for the management and operation of the ROTSE (Robotic Optical Transient Search Experiment) telescope at McDonald Observatory is in the process of being transferred to SMU. Prior to the discovery of SN 2012ha in November, Ferrante, Dhungana, and Kehoe also participated in the discovery of SN 2012fb in September and a nova in October.

SMU's Second Century Celebration & Physics History

As part of SMU's Second Century Celebration, the SMU Physics Department is working to collect video interviews of faculty and friends who have been part of SMU's first century.

Professor George Crawford received his B.S., M.S., and Ph.D. Degrees from the University of Texas and joined SMU in 1963. Professor Crawford served as Chair of the Physics Department, and helped design our very popular dual Physics—Engineering degree program. While at SMU he did extensive research on environmental issues, and after his retirement from SMU in 1992 he taught a course in the MLA program through 2005.

Professor George Crawford
Circa 1967

Professor Jeff Chalk received his B.S. & M.S. degrees as Rice University, and his Ph.D. at the University of Colorado. He joined SMU in 1965, and also served as Chair of the Physics department. While at SMU, Prof. Chalk served for 4 summers on the AAPT Demonstration Workshop staff. This led him to develop the many fascinating demonstrations which have now evolved into the popular Physics Circus Presentations. While physics students may forget the complicated formulas, they always remember the spectacular demonstrations. Professor Chalk also served as Director of the Dallas Science Fair in the 1980's. He retired in 1995, but continued to teach as an Adjunct for the department for many years.

Professor Jeff Chalk
Circa 1967

Both Professors Crawford and Chalk were hired by **Professor William Tittle,** and both were instrumental in initiating the Physics Ph.D. program in 1968. The program focused on nuclear physics and solid state physics, and was successful in bring external grant funding to the department. The program was suspended in the late 1970's, but later re-instituted in 1991; at present, we now have over a dozen physics students, and our graduates have gone on to fill prestigious faculty and industry positions.

Professor Jeff Chalk during a physics demonstration
Circa 1994

Robert Hyer Thomas (Right) with SMU Alumnus & Nobel Laureate Professor James Cronin (Center) and Professor Fred Olness (Left)

We also interviewed **Robert Hyer Thomas**, the grandson of SMU's first president, and physics professor, Robert S. Hyer. Just like his grandfather, Robert Hyer Thomas had a very close connection to SMU; he grew up in the SMU neighborhood, and received his BA and Law degrees from SMU.

For more details, tune into the **Mustang Physics Pod-Cast** where we will be posting excerpts and other interesting history of the Physics Department. The full-length video interview will also be archived as part of the SMU Library's new Digital Collections project.

Fermilab Today: Top quark mass team wages war on two fronts

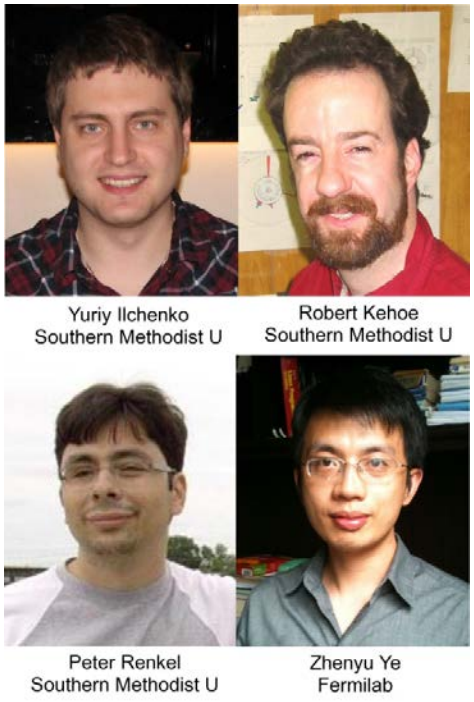
The research of SMU physicist Robert Kehoe, a professor in the SMU Department of Physics, has been featured by *Fermilab Today*. The magazine is the official publication of the U.S. Department of Energy's Fermi National Accelerator Laboratory near Chicago. Fermi is a high-energy particle physics laboratory credited in 1995 with discovery of the fundamental particle, the top quark.

Kehoe is part of the DZero collaboration of scientists who seek measurements of the top quark to determine the mass of the Higgs boson, another fundamental particle that has never been observed but which theoretical physicists have theorized generates mass for all particles that comprise matter. Others from SMU who were instrumental in the analysis include doctoral student Yuriy Ilchenko and post doctoral researcher Peter Renkel.

The paper "Measurement of the top quark mass in collisions using events with two leptons" was published by Fermilab. It reports DZero has obtained the world's most precise measurement in the dilepton channel of the top quark mass.

"The measurement precision is now down to 1.6% in these events, which is astounding given how rare dilepton events are," Kehoe said. "Perhaps more importantly, we have pursued a new way of calibrating these events that dramatically lowered the systematic uncertainty, and will allow it to decrease with more data — we have half the data yet to analyze."

These physicists, along with Jason South, Southern Methodist University, and Huanzhao Liu, Southern Methodist University, made major contributions to this analysis. This team maintained and monitored the operations of the DZero calorimeter and its contribution to the first stage of the triggering system that determined which proton-antiproton collisions were worth recording for use in analyses, such as the one above



Fermilab Today

Mike Cooke, Jan. 26, 2012

Two major factors contribute to the ultimate precision of a measurement of the top quark mass: the amount of data used to make that measurement and the understanding of the uncertainty introduced by the detector. The amount of data used affects the size of the statistical uncertainty of the measurement, while accounting for the bias of the detector effects leads to the systematic uncertainty. Since the final precision of a measurement can't be smaller than the larger of these two uncertainties, it is possible to have a measurement that is limited by the systematics. A systematically limited measurement won't improve by simply taking more data. The most recent top quark mass measurement at DZero succeeded in turning a systematically limited analysis channel into a statistically limited one.

The top quark always decays into a W boson and a bottom quark. The W boson can decay into a neutrino and a charged lepton, such as an electron or muon, or into quarks. The major distinction between top quark pair analysis channels is the number of leptonic W boson decays allowed. In the dilepton channel, both W bosons decay leptonically and two neutrinos are produced. However, the incomplete reconstruction of neutrinos in the DZero detector leads to ambiguity when studying these top quark pair events. To account for this ambiguity, DZero physicists considered all possible values of the neutrino parameters to determine the value of the top quark mass that best fits the DZero data set.

The major source of systematic uncertainty for this measurement is the response of our calorimeter to the energy deposit from the spray of particles, or jet, produced by each bottom quark. A previous DZero top quark mass measurement in the single charged lepton channel performed a precise calibration of jet energy by making use of the jets produced by the W boson that decayed to quarks. To reduce their systematic uncertainty, the dilepton analysis team based their analysis on that precision calibration while carefully accounting for the differences that might arise from applying that calibration in their particular channel. The improved systematic uncertainty helps make this result the world's most precise measurement in the dilepton channel and has now switched this channel from being systematically limited back to being statistically limited. Since this result uses about half of the full DZero Run II data set, it will improve when the additional data is added.

Alumni News: Where are they Now?

We enjoy hearing from our former students. Here is what some of them are up to now.

Shannon Thornton Clardy (B.S.) is an Assistant Professor of Physics and Adjunct Professor of Oboe at Henderson State University in Arkadelphia, Arkansas.

Rozmin Daya (Ph.D., 2011) is a Post-doctoral Researcher at Brandeis University and currently working on the ATLAS experiment at CERN.

Alonso N. Gutiérrez, (B.S.) is now an Assistant Professor, Department of Radiation Oncology, School of Medicine, The University of Texas Health Science Center in San Antonio, and also has a joint appointment in the Department of Radiology.

Holly Howard (Minor, 2012) is currently completing a Biomedical Certificate Program at the University of Texas at Dallas, and she will start medical school in the Fall. She was honored in 2012 with the Wiley Scholarship for Excellence in Physics for her undergraduate research which modeled neurons with electrical circuits.

Renat Ishmukhametov (Ph.D., 2012) is currently completing research at CERN, the European Organization for Nuclear Research, in France, and he will be teaching at Ohio State University this Fall.

B. Alexander King III, (M.S.) is Professor and Chair of the Department of Physics and Astronomy at Austin Peay State University in Clarksville, TN. He also serves as the Director of the Tennessee Governor's School for Computational Physics.

Martina Kolmeder (B.S.) is a free-lance photographer in Dallas and has a web and database design company.

Ilya Korolkov (Ph.D.) is a staff physicist at the Institute for High Energy Physics in Barcelona, Spain. He is working on the ATLAS project, using a general-purpose detector to collide protons against one another to search for the Higgs boson, extra dimensions, and dark matter particles.

Yuri Maravin (Ph.D.) is an Associate Professor at Kansas State University. He is on sabbatical working on the Compact Muon Solenoid (CMS) experiment at CERN in Geneva until 2013.

Connor O'Dell (BA, 2012) is seeking a Ph.D. in Mathematics from the University of North Texas through a teaching fellowship. As an undergraduate, he achieved Honor Roll status in 2010-2011.

Kelly Pearson (B.S., 2010) is a graduate student at the University of Hawaii studying oceanography. As an undergraduate, she had co-authored a research paper discovering several variable stars.

Cynthia Rollins (BS, 2012) is a certified Journeyman Electrician and member of the Institute of Electrical and Electronics Engineers, and is interested in developing Solar Technology.

Dennis Stanley (BA, 2012) is focusing on the health sciences at University of Texas San Antonio. He is working toward a Ph.D. in Medical physics with an emphasis on treatment and therapy at the university. He received the McDonald Scholarship for Excellence in Physics in 2012.

Kamile Yagci (Ph.D., 2012) is a tenure-track professor of physics at North American University in Houston, Texas. She completed her research this year on the ATLAS experiment looking for evidence of extra spatial dimensions.

Kevin Yarritu (B.S.) received his Ph.D. Degree in Physics from Stanford University and now works at Los Alamos National Laboratory.

The SMU Department of Physics faculty would like to congratulate our December 2012 graduates.
[From left to right in photo: Prof. Vega, Prof. Kehoe, Prof. Hornbostel, Santosh Adhikari, Yuriy Ilchenko, Prof. Sekula, Matthew Rispoli, Prof. Olness, Prof. Cooley.]

Thank You For Keeping In Touch:

The physics department now has a regular, free audio program (podcast) called "Mustang Physics" **http://blog.smu.edu/mustangphysics**

We are looking for alumni contributions to the program. If you are interested, please contact Professor Stephen Sekula at ssekula@smu.edu or (214)-768-7832

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

- Inform us of any address changes in the future so we can stay in touch.
- 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