

PHYSICS

at SMU



An occasional newsletter for alumni and friends.

Spring 2011

Chairman's Report



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

Professor & Nobel Laureate **Frank Wilczek** will present the Lightner-Sams Lecture at SMU on Thursday April 28, 2011. Reservations are required for this banquet presentation; please contact the Physics Department for information.

The Department organizes the **Beal Bank Dallas Regional Science & Engineering Fair**. Grand Prize winner **Amy Chyao** had the opportunity to present her project to the President at the White House, and attend the State of the Union address.

Professor **Ryszard Stroynowski** is spending a year in Geneva, Switzerland at the CERN lab working on the ATLAS detector of the Large Hadron Collider (LHC). Already the LHC is observing phenomena that cannot be readily explained within the conventional "Standard Model."

The SMU Opto-electronics lab set a world record for an Application-Specific-Integrated-Circuit (ASIC) designed for high speed data

transmission in particle physics experiments. Professor **Jingbo Ye** supervises this effort.

Professor **Pavel Nadolsky** received an Early Career Research Award (ECRA) from the US Department of Energy; he was one of 5 particle theorists nationwide who received this award which recognizes his excellence in studies of fundamental interactions.

Professor **Jodi Cooley** was featured in November in an interview by reporter Jonathan Betz of Dallas ABC affiliate WFAA. The video clip is linked from the Physics webpage.

Professor **Steve Sekula** has initiated *Mustang Physics Podcasts*. (See page 12 for details.)

The Department is pleased to announce that graduate students **Bedile Karabuga** and **Rozmin Daya** have received the Lightner-Sams Fellowship Awards, & **Renat Ishmukhametov** and **Ryan Rios** have received the **Tittle Award** to support their research.

Additionally the Department supports a number of undergraduate students with scholarships awarded in honor of Professor Emeritus **Jeff Chalk**, and we also have undergraduate research assistants supported by **Hamilton** scholarships.

Our computing facility received a substantial boost with major grants from the office of the SMU Provost and US the Department of Energy.

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

Nobel Laureate Frank Wilczek to present Lightner-Sams Lecture at SMU

Professor Frank Wilczek will present the Lightner-Sams Lecture at SMU.

We invite our alumni and friends to join us for this special event.

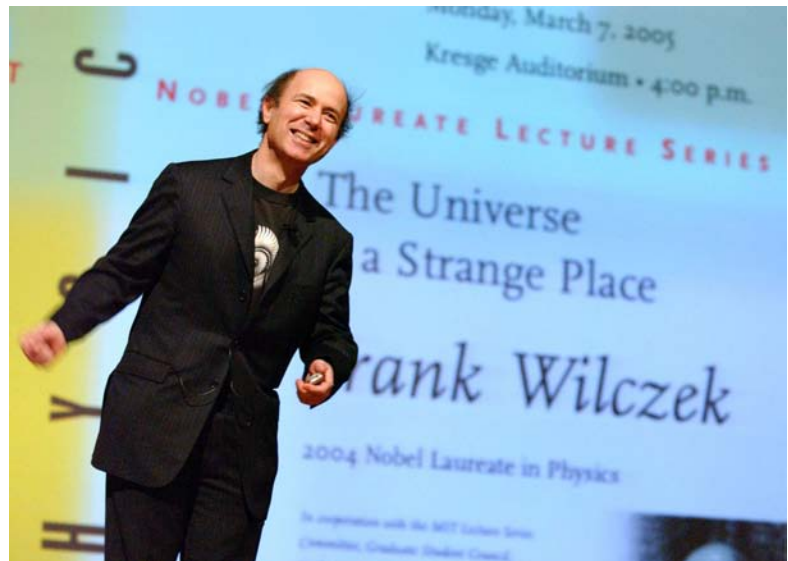
Thursday, 28 April 2011

Time: 6:00pm Reception

7:00pm Banquet

Reservations Required

*Contact the Physics Department
for details*



Frank Wilczek public lecture at MIT, 2005.
(Photo courtesy of Justin Knight Photography.)

Frank Wilczek Biography

Frank Wilczek has received many prizes for his work in physics, including the Nobel Prize of 2004 for work he did as a graduate student at Princeton University, when he was only 21 years old.

He is known, among other things, for the discovery of asymptotic freedom, the development of quantum chromodynamics, the invention of axions, and the exploration of new kinds of quantum statistics (anyons).

Much in demand for public lectures to a wide range of audiences, Frank has been anthologized in the Norton Anthology of Light Verse and twice in Best American Science Writing (2003, 2005). His television appearances include "ghostbusting" for Penn and Teller (2005).

Longing for the Harmonies, a beautiful exposition of modern physics Frank wrote with his wife Betsy Devine, was named a NY Times Notable Book of the Year and has recently been re-issued in paperback. Frank is also the author of Fantastic Realities, a "playful yet profound"

(to quote one reviewer) collection of his short pieces on wide-ranging topics, which concludes with a family's-eye view of the Nobel adventures, drawn from Betsy's blog Funny Ha-Ha or Funny Peculiar.

Early reviews have called Frank's latest book, *The Lightness of Being*, "a lively, playful, and inventive tour de force" as well as "a colorful and masterful treatment of recent developments in fundamental physics." A central theme of this book is that the ancient contrast between celestial Light and earthy Matter has been transcended. In modern physics, all the stuff out there is unified into a "Being" more like the traditional idea of light than the traditional idea of matter.

Frank grew up in Queens, NY and attended the University of Chicago. After getting his Ph.D. from Princeton, he spent time on the faculty there and at the Institute for Advanced Study, as well as at UCSB's Institute for Theoretical Physics, now the KITP. Frank is currently the Herman Feshbach professor of physics at MIT.

Nadolsky earns DOE Award



By Kathleen Tibbetts

*Posted in Energy & Matter,
May 12, 2010*

Southern Methodist University physicist **Pavel Nadolsky** will receive \$750,000 over five years to fund his work in modeling particle interactions through a new program administered by the Office of Science, U.S. Department of Energy (DOE).

Nadolsky, assistant professor of theoretical physics in the SMU Department of Physics, received the grant for his integrated analysis of particle interactions created by hadron colliders. He was one of 69 researchers chosen through peer review by scientific experts to participate in the DOE's new Early Career Research Program. About 1,750 applicants submitted proposals.

Funding meant to boost scientific workforce

Early Career Scientists receive funding under the American Recovery and Reinvestment Act of 2009 in an effort "to bolster the nation's scientific workforce by providing support to

exceptional researchers during the crucial early career years, when many scientists do their most formative work," according to a DOE statement.

Nadolsky works with an SMU team of postdoctoral research associates and graduate students to model hypothetical interactions of subatomic particles for the biggest physics experiment in history: the Large Hadron Collider (LHC) near Geneva, Switzerland.

The LHC became fully operational on March 30, 2010, and the high-speed, high-energy particle collisions it creates will allow physicists to recreate conditions at the origin of the universe — and possibly discover the mechanisms that cause particles in space to acquire their differences in mass.

Tiny particle research aids search for new physics

As part of the effort to identify theoretical new particles such as the Higgs boson, Nadolsky develops highly detailed computer simulations both of known particle interactions and of the expected tiny deviations that LHC researchers hope to discover. Each collision produces a staggering amount of raw information, and the most useful bits are few and far between: Out of 40 million events per second, the researchers may be looking for as few as 10 events a year.

"The phenomena we're looking for will be buried under a lot of known particles produced by ordinary means," Nadolsky says. "Our task is to produce the most accurate models possible of known interactions, so we can recognize the interactions that deviate, and why."

Without such models, identifying new events at the LHC would be difficult, if not impossible, he adds.

Nadolsky received his doctorate from Michigan State University in 2001 and joined SMU as a postdoctoral research fellow from 2001 to 2004. He also did postdoctoral research with the High Energy Physics Theory Group at Argonne National Laboratory in Illinois from 2004 to 2007. He returned to SMU as a faculty member in 2008.

SMU physicist presents team's important dark matter find



Jodi Cooley-Sekula

Assistant Professor of Experimental Physics

Physicists have been searching for dark matter — the substance that makes up most of the matter in the universe — for decades. Now an international collaboration of physicists working in an abandoned mine in Minnesota have announced there's a chance they may have spotted a glimpse of the subatomic particles. One of two scientists presenting the finding simultaneously on opposite coasts was physicist Jodi Cooley, an SMU assistant professor of experimental particle physics.

Professor Jodi Cooley presented the results of the Cryogenic Dark Matter Search (CDMS) experiment on behalf of her collaboration in seminar at SLAC National Laboratory which was simultaneously webcast around the world. As reported in the 18 December 2009 of the NY Times Cooley and her team found two events with characteristics consistent with those expected from dark matter. Although this was not enough events to claim a discovery of the elusive particle, the result restricts the characteristics of some favored dark matter candidates put forth by theorists. The result was published in *Science* (327: 1619-1621, 2010).

White House Science Fair

Out of several million projects, the best science fair project in the world this year came from the **Beal Bank Dallas Regional Science & Engineering Fair** which is organized by SMU Physics led by Dr. **Simon Dalley** and **Randall Scalise**. Student **Amy Chyao** won the top prize at the 2010 Intel International Science and Engineering Fair which was held in San Jose this past spring.



Amy Chyao, Beal Bank Dallas Regional Science & Engineering Fair (DRSEF) 2010 Grand Prize winner, presents her project to the President at the inaugural White House Science Fair. She was also invited to the recent State of the Union address. You can watch the video of the 2010 Fair on **YouTube**.

LHC Begins Operation

The ATLAS detector began operation in March 2010. **Prof. Ryszard Stroynowski** will spend the 2010-11 academic year in residence at the CERN lab and will have a first-hand glimpse of any new physics signatures that ATLAS might uncover. In August he served on a panel advising US Department of Energy on the choices of future projects for "High Intensity Frontier" in High Energy Physics.

Prof. Jingbo Ye has been appointed level II deputy manager for US-ATLAS LAr upgrade program, representing to upper management and funding agencies (DOE and NSF) the R&D work on ATLAS upgrade at BNL, Columbia Univ., Univ. of Penn, Univ. of Arizona, and SMU, and coordinate the US efforts with the European colleagues.

Honorary Degree

Prof. Thomas Coan proposed and sponsored UC Berkeley's **Saul Perlmutter** for an SMU honorary degree, awarded at the spring 2010 commencement. Prof. Perlmutter is an eminent physicist who leads an international team that studies distant exploding stars to measure the expansion of the universe and is widely credited as the discoverer of "dark energy."

Top Quark Measurement

SMU's team on the D0 experiment, Assoc. Prof. **Robert Kehoe**, post-doc **Peter Renkel**, graduate students **Yuriy Ilchenko** and **Huanzhao Liu**, and undergraduate **Jason South**, made substantial progress toward a precision measurement of the top quark mass in events with one electron and one muon. With an increased data sample, and improved analysis techniques, the uncertainty on this measurement alone was reduced by a factor of two. The top quark mass is very interesting because it may hint at a special role for the top quark to be the particle responsible for generating mass for fundamental particles, a role generally attributed to the Higgs boson. This measurement is the world's most precise in events with two leptons.

Congratulations

Congratulations are in order for postdoctoral fellow **David Joffe** who has received a Assistant Professor Position at Kennesaw State University located in Atlanta, Georgia. David will begin teaching and research there in the Fall semester.

Theorist of the Week

Prof. Fredrick Olness was named the inaugural lecturer in a program launched by the DESY laboratory, Germany's premier research center for particle physics. DESY's "Theorist of the Week" program brings prominent theorists from around the globe to spend a week at the lab's analysis center in Hamburg, Germany. Olness, who visited the laboratory in March, was the program's first guest physicist.

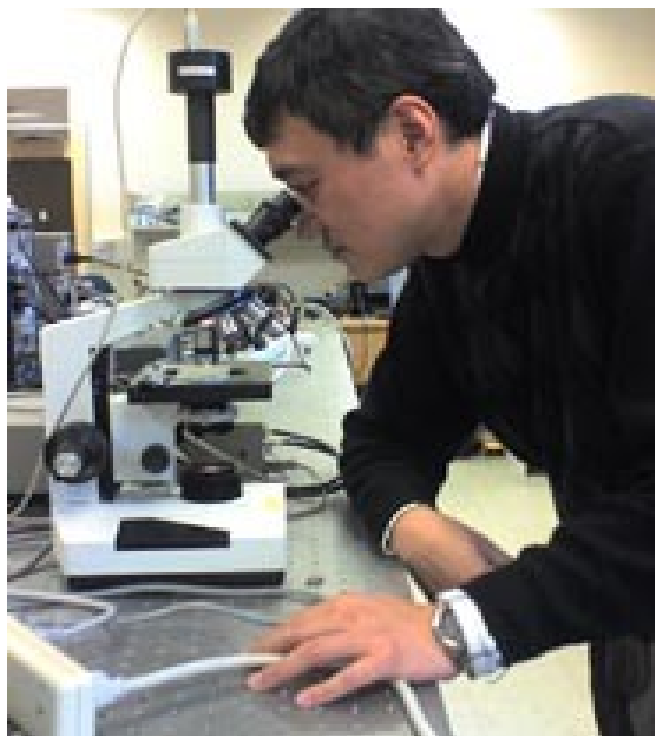
Undergraduate Research

Undergraduates have been very busy in a wide range of interesting research in the past year. Several students presented posters in SMU's annual Research Fair in February 2010. This was the first event to include undergraduates, and major **Kelly Pearson** won the undergraduate award for her search for rapidly variable stars. **Joseph Hashem** completed work to calibrate picoammeters for our department's top-notch opto-electronics lab. His research was published in the American Journal of Undergraduate Research this Fall. Joe and Kelly have gone onto graduate school at UT Austin and U of Hawaii, respectively.

Landon Banister has been developing search strategies this year with data from the BaBar experiment to look for dark bosons in decays of B mesons. He presented his work at a collaboration meeting in Cincinnati. **Jason South** performed a study of the model inputs involved in our measurement of the top quark mass with the D0 detector, with results shown at conferences this summer. **Sylvia Bertoni** worked on a theory project to identify new algorithms for working with data points in many dimensions.

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. Four of our students have won Hamilton Scholar awards this year. Three participated in the first annual Physics Research Fair on Oct. 1, and attendance was quite high. SMU's Vice President for Research, **Dean James Quick**, attended with very positive comments about the students' progress. We are sending three of our students for the first time to the National Conference on Undergraduate Research in Ithaca, NY.

New high-speed integrated circuit sets world record



Jingbo Ye views SMU LOC serializer

By Margaret Allen,

Posted in Energy & Matter, Technology

April 7, 2010

A new high-speed integrated circuit to reliably transmit data in the demanding environment of the world's largest physics experiment is the fastest of its kind.

This new "link-on-chip" — or LOC serializer circuit — was designed by physicists at Southern Methodist University in Dallas as a component for use in a key experiment of the Large Hadron Collider particle accelerator in Europe.

The miniscule SMU LOC serializer was designed for ATLAS, which is the largest particle detector at the Large Hadron Collider.

The LHC, as it's called, is a massive, high-tech tunnel about 100 meters underground. Within the LHC's circular, 17-mile-long tunnel, protons traveling at high energy are smashed together

and broken apart so physicists worldwide can analyze the resulting particle shower detailed in a flood of electronic data.

Data holds key to bold new physics discoveries

The data transmit from the LHC via a tiny serializer circuit enabling electronic readouts. Physicists analyze the data to discover answers to unsolved scientific mysteries such as the Big Bang, dark matter, black holes, the nature of the universe and the Higgs particle that gives mass to quarks and electrons. SMU is a member of the ATLAS Experiment.

The LHC is a program of the Geneva-based international scientific consortium known as the European Organization for Nuclear Research, or CERN. In March CERN announced that the LHC had successfully begun colliding protons at an energy three and a half times higher than previously achieved at any particle accelerator.

SMU LOC designers challenged by LHC's formidable environment

SMU's new world's-fastest LOC serializer is what the industry calls an integrated circuit made for a specific use, or "ASIC" for application-specific integrated circuit. It was designed for the LHC's high-radiation environment, as well as for high data bandwidth, low-power dissipation and extremely high reliability, said physicist Jingbo Ye. An associate professor of physics, Ye led development of SMU's LOC serializer.

Hunt for Higgs boson

The SMU LOC serializer was perfected over the past three years in the SMU Research Laboratory for Optoelectronics and ASIC Development in the Department of Physics. An added feature of the SMU LOC serializer is that it can operate at cryogenic temperatures and has been tested down to liquid nitrogen temperatures of -346 degrees Fahrenheit.

It was designed to transmit data for the optical link readout system of the ATLAS Liquid Argon Calorimeter, an ATLAS sub-detector that measures the energies of electrons and photons generated at the center of ATLAS where protons collide. Because the electronic readout components are in the center of the ATLAS detector, they are essentially inaccessible for routine maintenance, so reliability is paramount, Ye said.

Serializer transmits data shower from colliding protons

With a data transmission rate of 5.8 billion-bits per second, the SMU LOC serializer represents the first milestone for the SMU-led team. The team plans to develop an even faster ASIC serializer that transmits data at up to 10 billion-bits per second. Faster circuits are critical as CERN continues increasing the LHC's luminosity, thereby generating more and more data.

"SMU's LOC serializer is the fastest in our field for the moment," Ye said. "CERN is developing another fast ASIC serializer that does not yet match our speed. SMU's next goal is to increase both the data speed and the number of data lanes to produce an even faster LOC serializer. In the next few years, we hope to increase the total speed by a factor of 62 more than what is installed in ATLAS."

Ye presented the SMU LOC serializer design in February at CERN. Made of complementary metal-oxide-semiconductor transistors in silicon-on-sapphire, the serializer's design details also will be presented to scientists in April in Hamburg during the ATLAS Upgrade Week at the DESY laboratory, Germany's premier research center for particle physics. The SMU LOC serializer research was funded by the National Science Foundation and the U.S. Department of Energy.

The existing LOC serializer in use at present in the ATLAS Liquid Argon Calorimeter was previously developed and installed by an SMU-led team of physicists and engineers from France, Sweden, Taiwan and the United States.

Faster serializer a critical component for Super LHC

SMU's new LOC serializer is critical for the upgrade of the Large Hadron Collider, called the Super LHC, which is planned to go online in 2017, Ye said.

"The original ATLAS design used a commercial serializer that was purchased from Agilent Technologies," Ye said. "But for the Super LHC there is no commercial device that would meet the requirements, so — being typical physicists — we set out to design it ourselves."

The ATLAS Liquid Argon Calorimeter's existing optical link system, delivered by SMU physicists, has a data bandwidth of 2.4 terabits per second over 1,524 fibers, or 1.6 billion bits per second per fiber, more than 1,000 times faster than a T1 line of 1.544 megabits per second. The next generation of this optical link system will be based on the new SMU LOC serializer, and it will reach 152.4 terabits per second for the whole system.

More selectivity with faster data transfer

"Fast information transfer from the detector to the computer processing system is a necessity for handling the significantly increasing amounts of data expected in the next round of LHC experiments," said Ryszard Stroynowski, U.S. Coordinator for the ATLAS Liquid Argon Calorimeter, and chair and professor of physics at SMU. "It will allow ATLAS to be more selective in the choices of events sent for further analysis."

A radiation-tolerant, high-speed and low-power LOC serializer is critical for optical link systems in particle physics experiments, Ye said, noting that specialized ASIC devices are now common components of most readout systems.

"The ever increasing complexity of particle physics experiments imposes new and challenging constraints on the electronics," Ye said. "The LOC serializer was a formidable task, but our team was up to the challenge."

Society of Physics Students ($\Sigma\Pi\Sigma$) News

SPS Students Tour Silicon Valley



The SPS students and Prof. Sekula pose in front of the Stanford Large Detector

In May, 2010, the SMU Society of Physics Students traveled to the San Francisco Bay Area in California for a tour of scientific, technological, and educational facilities. Eight undergraduates were accompanied by **Professor Stephen Sekula** to see the SLAC National Accelerator Laboratory, the Lick Observatory high above San Jose, Google, and the Exploratorium, a world-class, hands-on science education facility located just a couple of miles from the Golden Gate Bridge.

The tour of SLAC was given by a Stanford graduate student, who showed off the 2-mile electron-positron linear accelerator and its main control center, the Stanford Large Detector (in the background of the photograph below), and the BaBar Detector (two of the SPS students attending the trip conduct research using data from this experiment). While eating lunch in the SLAC cafeteria, the group was sitting at a table right next to one of SLAC's three Nobel Prize winning physicists!

The second day of the trip involved a journey to Mount Hamilton to see the Lick Observatory. Among its many studies, it was the site of the first U.S.-based test of Albert Einstein's General Theory of Relativity. The top of Mount Hamilton is dotted with many different telescopes, large and small, most still used by astronomers who travel from across the world to live on the mountain and make observations. Day three of the trip involved a visit to the campus of Google, where two former particle physicists, now Google engineers, gave us a tour of the campus and discussed how their work in physics plays a role in their present work at Google.

The last day of the trip was spent at the Exploratorium, a landmark science education facility in the heart of San Francisco. The vast warehouse space is filled with hands-on science experiments, from a giant magnet that sculpts its magnetic field into handfuls of sand, to a cloud chamber with subatomic particles streaking through its vapors, to a giant tornado demonstration.

The SPS is extremely grateful for the support of the Lightner Foundation, which generously provided a budget for the trip. This was a unique opportunity to expose the future leaders of science and technology to the many frontiers of physics research, information technology, and education!

SMU Physics QuarkNet Program for HS Science Teachers



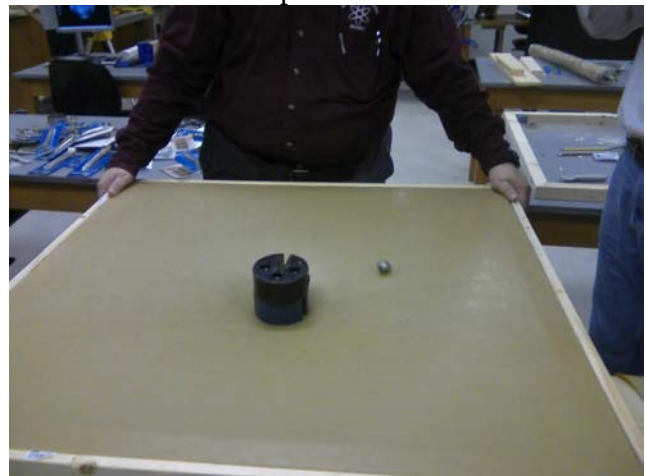
The SMU Particle Physics Group sponsored its annual QuarkNet Workshop the week of August 9-13, 2010, an event which it has organized annually since 2001. This year's workshop included 16 teachers, all but one of whom were QuarkNet regulars. There were male and female teachers representing Dallas area high schools, public and private, single sex and regular schools, as well secular and religious schools. Together with 7 SMU personnel, 3 local students, and a number of QuarkNet personnel, it was a lively event.

The workshop format included a 3-day cosmic ray mini-workshop followed later in the week by lectures by SMU faculty and the teachers themselves, as well as our ever-popular 'make-and-take' labs. QuarkNet's Bob Petersen came from Fermilab to lead the construction of 2 new cosmic ray detectors, bringing the SMU center's total to 6, and the introduction to the cosmic ray e-lab.

The theme this year was relativity and teachers Rich Lines and Trina Cannon gave introductory lectures on Einstein's General Theory. SMU faculty **Randy Scalise & Simon Dalley** then spoke on Relativistic Rockets and Extra Dimensions, with SMU graduate student Kamile Dindar giving an update on the search

for extra-dimensional gravitons at hadron colliders. This year lunches were provided on site, to keep the group together, facilitating many lively discussions about space, time, black holes and the current research problems such as dark matter and dark energy.

Aside from constructing the CRDs, the teachers each made a table-top demonstration of curved



space to illustrate the force of gravity in General Relativity. The apparatus used a pure gum rubber sheet stretched across a wooden frame and teachers came up with their own modification of the basic design.

Links to more pictures, and class materials:

<http://www.physics.smu.edu/scalise/quarknet>

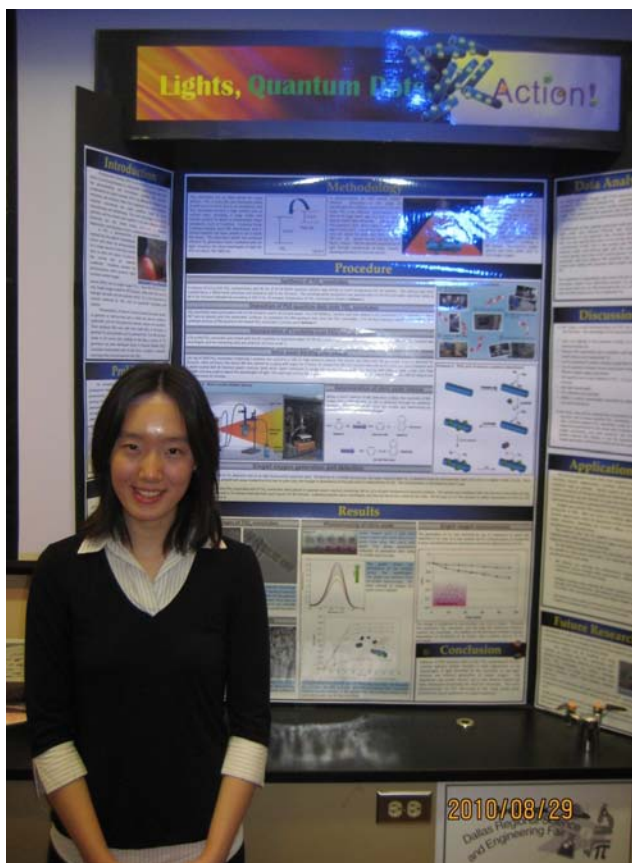
Mentors: Simon Dalley, Randy Scalise

Beal Bank Dallas Regional Science & Engineering Fair



Faculty and staff of the SMU Physics Department organized the **2010 Beal Bank Dallas Regional Science & Engineering Fair (DRSEF)**. Nearly 900 middle and high school students and 350 judges registered from the Dallas area. They gathered at Fair Park on February 27 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 Provost Paul Ludden, Texas Instruments Vice President Gregg Lowe, and SMU student (and former DRSEF winner) Jupin Mahli .



Grand Prize Winner Amy Chyao

DRSEF President and Physics Department faculty member **Simon Dalley** commented, “This year’s projects were very strong. Our high school students went on to dominate the grand prizes at the Texas State Science Fair and one of our grand prize winners, **Amy Chyao, (pictured at left)** went on to become World Champion at the 2010 International Science and Engineering Fair.” Her project developed a photosensitizer for photodynamic therapy (PDT), an emerging cancer treatment that uses light energy to activate a drug that kills cancer cells.

Ms. Chyao was the star attraction at the 2010 Fluor Science Fair Workshop held on August 28 in Dedman College. Organized by SMU Physics Department, over 400 students, parents, and teachers attended, most of them newcomers.

They heard informative and motivational talks, and got the chance to experience the unforgettable Physics Circus performed by **Randy Scalise, John Cotton** & Physics Department Head, **Fred Olness**.

Lightner-Sams Graduate Fellowship Awards

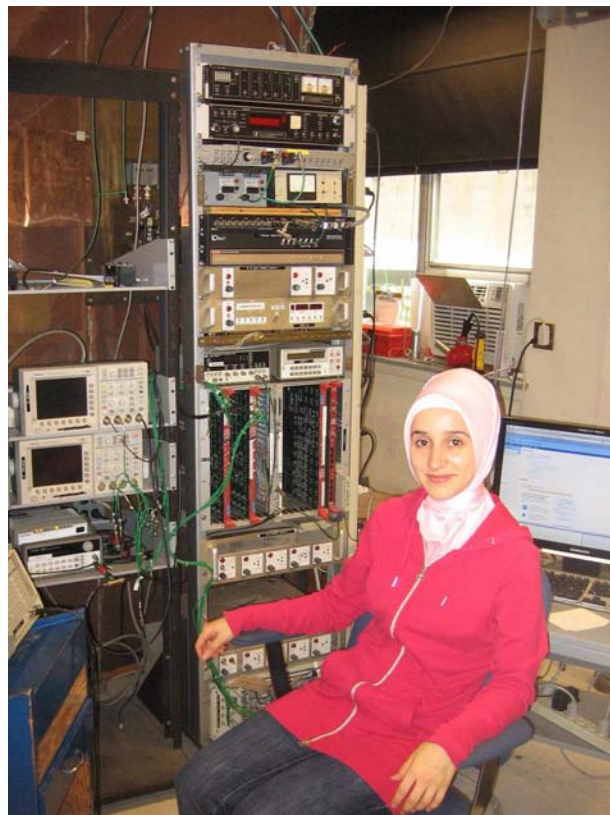
For the past several years the Lightner-Sams Foundation has provided funds for Fellowships for outstanding graduate students in Physics. This year's recipients are **Bedile Karabuga** and **Rozmin Daya**.

Ms. Karabuga is working on the Super-CDMS, (Cryogenic Dark Matter Search) experiment which is located in the Soudan Iron Mine in northern Minnesota. The experiment is deep under the earth to shield out the cosmic-ray radiation so that the detector technology can "listen" for the passage of dark matter through the earth. Dark matter is currently believed to be a non-luminous form of matter which makes up 85% of the matter in the universe.

Ms. Daya is working on the ATLAS Experiment which studies proton collisions generated by the Large Hadron Collider (LHC) which is located in Geneva Switzerland. The LHC began taking data in early 2009, and is presently analyzing the results of this first run as the collaboration searches for signals new physics.



Rozmin Daya



Bedile Karabuga

SMU Physics Opto-Electronics Lab Receives Grant Award

The Opto-Electronics Lab has received \$97,000 equipment support from Department of Energy (DOE). An ultra-high bandwidth (100 GHz) sampling oscilloscope, a 12.5 gigabit per second (Gbps) parallel channel bit error rate tester (BERT), and a field programmable gate array (FPGA) based high speed portable test platform have been ordered. The oscilloscope enables measurements on the fastest optical signals. The BERT provides a highly cost-effective solution for characterizing crosstalk susceptibility, backplanes and multi-lane serial data systems. The FPGA is a portable test platform. With all three, we can boost our test capability to multiple 10 Gbps channels and better fulfill our commitment in the ATLAS upgrade program and in the new experiments such as the long baseline

neutrino experiment (LBNE) liquid argon time projection chamber front-end readout.



ALUMNI NEWS



The SMU Department of Physics would like to congratulate SMU undergraduates Don Davis (shown above in blue robes, third from the right) and Courtney Fagg, and SMU graduate student Yichen Li, for the successful completion of their degrees in December 2010! *[From left to right in photo: Prof. Jodi Cooley, Prof. Robert Kehoe, Prof. Tom Coan, Don Davis (B.S.), Prof. Steve Sekula, Prof. Kent Hornbostel.]*

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>