



## Chairman's Report



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

In Spring 2015 the Large Hadron Collider (LHC) will start-up at nearly double the energy used in 2012 to discover the Nobel Prize winning Higgs boson. The world will be watching, and SMU Physics will play an important role in this experiment. SMU Faculty members on the LHC ATLAS experiment include **Professors Stroynowski, Kehoe, Sekula, & Ye**.

The topic of our 2015 Spring **Physics Symposium** will be Astrophysics & Cosmology. Specifically, we'll examine the search for Supernovae and also for Dark Matter. The dinner and lecture will be held on Sunday, 12 April 2015. (Detailed information on page 2.)

We are pleased to host the **International Workshop on Deep-Inelastic Scattering** in April 2015 (DIS2015). This meeting is the premier international meeting that brings experimentalists and theorists together from across the globe; recent meetings were held in Poland, France, Germany, Japan and Russia.

In combination with the DIS2015 meeting, we will host a **Public Lecture: *If the Universe is the answer, what is the question?*** This will feature 4 physicists discussing the impact of the recent LHC results. The event is open to the public and will be held Sunday 26 April 2015 from 6:30—7:45pm in the Hughes Trigg Student Center. (More info on page 4.)

The SMU Physics Department successfully renewed our US DoE and NSF grants, and continues to bring in over \$2M of external funding annually.

**Prof. Jingbo Ye** received an NSF grant for \$2.5 million to develop optical links for the ATLAS experiment.

**Prof. Jodi Cooley** organized two international scientific conferences.

**Prof. Pavel Nadolsky's** new study on “meta-PDFs” was published in a physics journal, and also on the white board on the “Big Bang Theory” sitcom.

**Prof. Ryszard Stroynowski** was invited to participate in the DoE Office of Science Intensity Frontier panel.

**Prof. Steve Sekula** will convene a future physics program on the Higgs boson hosted by the Kavli Institute at UC-Santa Barbara.

**Dr. Simon Dalley** received the 2014 Provost Teaching Recognition Award for his dedication to teaching and learning.

**Prof. Fred Olness** was invited by CERN to convene a subgroup for the LHeC lepton-hadron collider as part of a 3-year study.

Physics hosted our annual NSF-funded QuarkNet program. Eighteen science teachers from DFW participated in the one-week summer institute. This is organized by **Simon Dalley** with help from **Randy Scalise** and **Fred Olness**.

Congratulations to Physics Major **Nicole Hartman** who won a national Goldwater Scholarship Award.

Congratulations to **Mayisha Nakib** and her mentor **Prof. Jodi Cooley** who received the Texas Section of the American Physical Society Robert S. Hyer Award.

The **Master Physics Teacher Certificate (MPTC)** program continues in 2014-15 with new support from the **Hoglund Foundation** and the **Fluor Foundation**. This program is joint between Dedman College and the Simmons School. Organized by **Simon Dalley** with instruction by **Randy Scalise, Farley Ferrante, Dara Williams-Rossi**, and guest lecturers.

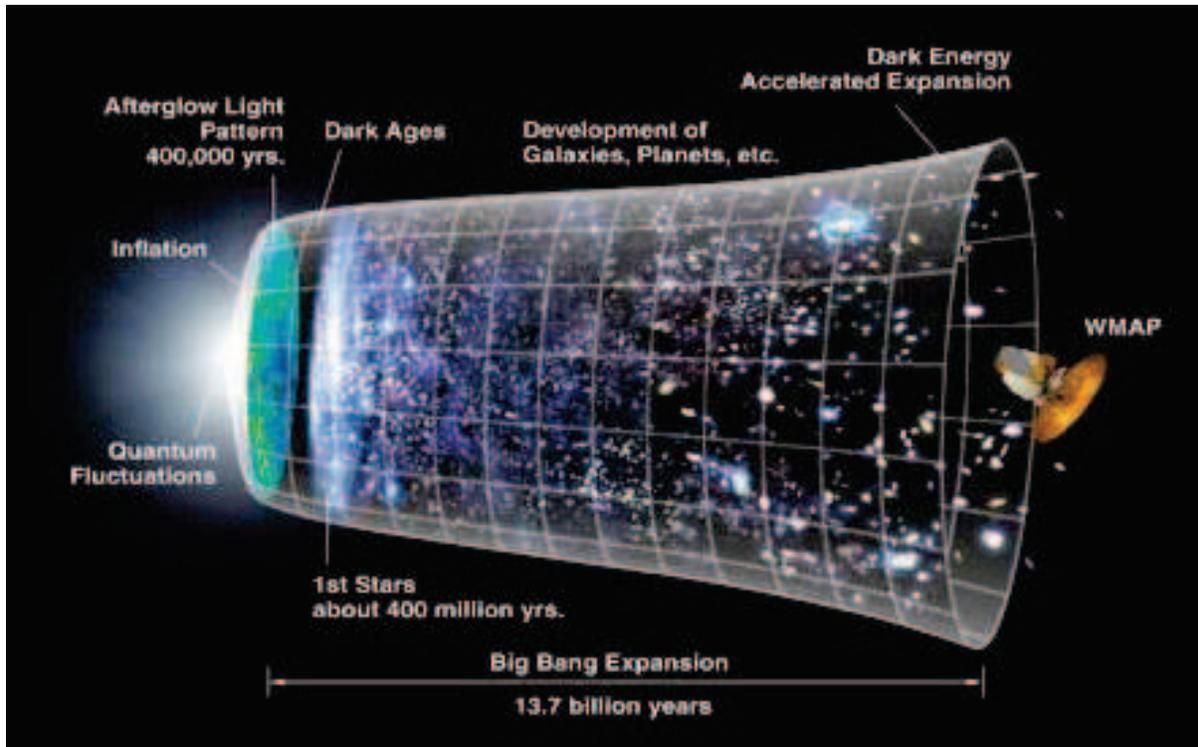
The Physics Department and SMU volunteers organized the **2015 Beal Bank Dallas Regional Science & Engineering Fair** together with several campus satellite events. Approximately 1,000 students were interviewed by 400 judges as they competed for more than \$100,000 of prizes. The fair is led by **President Dalley** with support from **Vice-Presidents Randy Scalise & Fred Olness** and other faculty.

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*

# Through a Cosmos Darkly

## The quest to Shine Light on a Dark Universe



A revolution in our understanding of the cosmos is unfolding, right before our eyes.

Can't see it? That's the mystery.

We used to think that if we understood ordinary matter, which readily interacts with light, that we would understand everything. But such matter comprises only a small fraction of the universe. Much of the matter that shapes the cosmos appears to be "dark matter" - it doesn't interact with light, and its composition is a mystery.

We used to wonder if the universe would one day collapse back on itself. But we learned that not only is cosmos expanding - it's doing so faster every day.

Join us for a night of wonder, so that together we can explore these profound mysteries of the universe. You can't see them, but they are twin revolutions in our understanding of everything.

### Physics Symposium Sunday, 12 April 2015

Time: 6:00 PM Reception  
6:30 PM Banquet

*Reservations Required*

*Please contact the Physics Department*

*For more details*

[www.physics.smu.edu](http://www.physics.smu.edu)

214-768-2495

*Please join us for a thought-provoking evening!*

# PHYSICS SYMPOSIUM GUEST LECTURERS



Professor Mustapha Ishak-Boushaki (UT-Dallas) studies theoretical cosmology and relativity, including gravitational lensing and its application to cosmology. This research will help us understand the acceleration of the expanding universe and elucidate questions about the cosmological constant, dark energy and modified gravity. He completed his Ph.D. at Queen's University at Kingston in Canada in Cosmology and General Relativity where his research focused on investigations in inhomogeneous cosmological models; an inverse approach to Einstein's equations; oscillation modes in compact astrophysical objects; and matching spacetimes using junction conditions. After a postdoctoral fellowship at Princeton University, he moved to UT-Dallas in 2005.



Professor Robert Kehoe's (SMU) research lies in experimental particle physics and astrophysics. In particle physics, he focuses on the study of the heaviest fundamental particles known, the Higgs boson and the top quark, to understand how mass is generated in nature. Prof. Kehoe was involved in one of the three analyses on the ATLAS experiment that resulted in the discovery of the Higgs boson in 2012. His astrophysics interests involve the study of the deaths of massive stars, such as supernovae and gamma-ray bursts. This work can improve our understanding of the experimental measurements that indicate an accelerating expansion of the universe, termed 'dark energy'. Kehoe is also a member of the Dark Energy Spectroscopic Instrument, a telescope proposed to dramatically improve our understanding of dark energy. He completed his Ph.D. in particle physics at the University of Notre Dame, where his research focused on the search for and measurement of the top quark. He performed one of the five analyses on the D0 experiment that contributed to

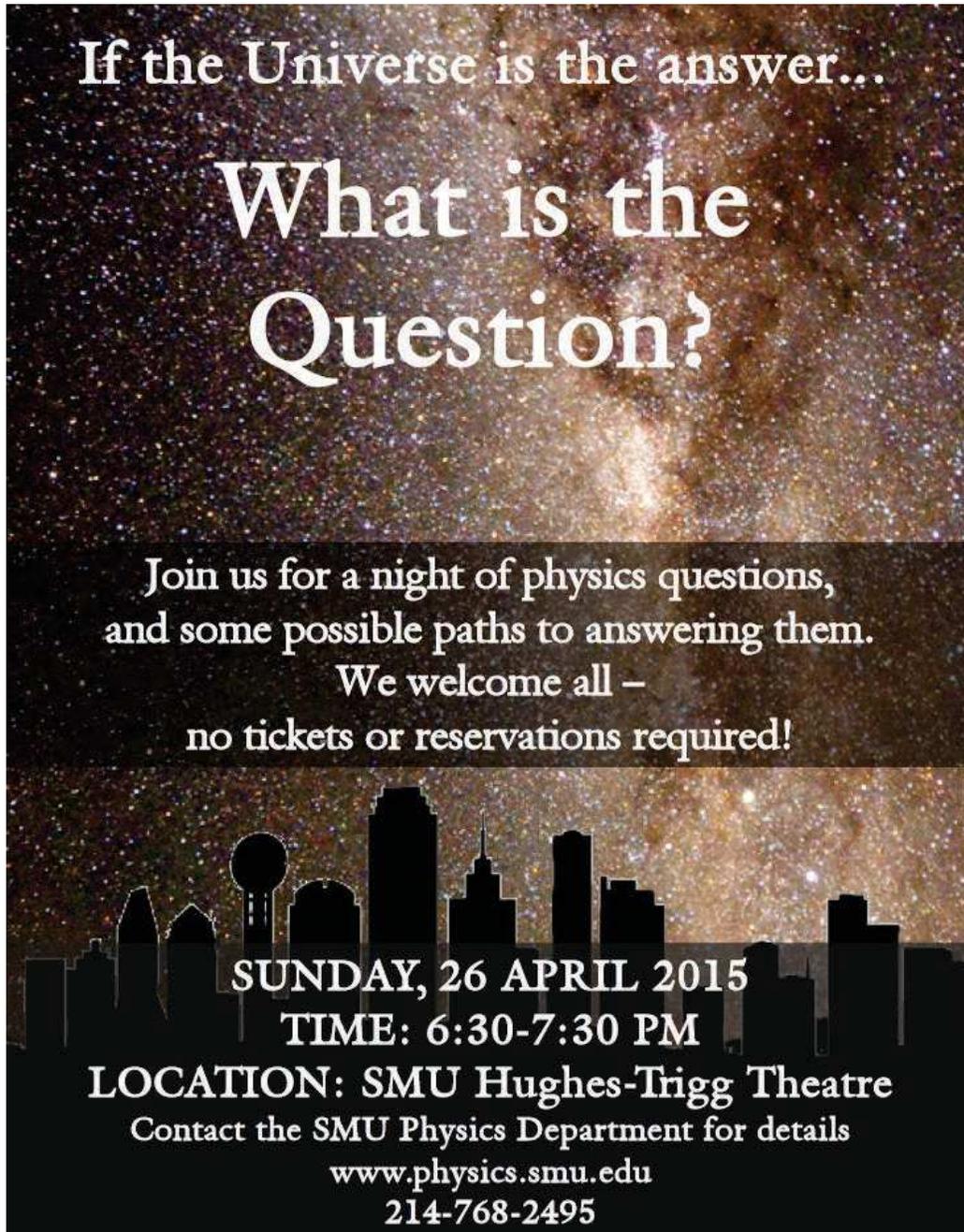
the discovery of the top quark. As a Research Fellow at the University of Michigan, Kehoe studied the physics of gamma-ray bursts, resulting in the discovery of the first optical emission during the gamma-ray phase. Kehoe has been at SMU since 2004.



Dr. Jodi Cooley received a B.S. degree in Applied Mathematics and Physics from the University of Wisconsin in Milwaukee in 1997. She earned her Masters in 2000 and her Ph.D. in 2003 at the University of Wisconsin - Madison for her research searching for neutrinos from diffuse astronomical sources with the AMANDA-II detector. Upon graduation she did postdoctoral studies at both MIT and Stanford University. She joined the faculty at SMU as an assistant professor of physics in 2009. Dr. Cooley is a Principle Investigator on the SuperCDMS dark matter experiment and a Principle Investigator for the AARM collaboration which aims to develop integrative tools for underground science. She has won numerous awards for her research including an Early Career Award from the National Science Foundation and the Ralph E. Powe Jr. Faculty Enhancement Award from the Oak Ridge Associated Universities. She was named December 2012 Woman Physicist of the Month by the American Physical Societies Committee on the Status of Women and earned a 2012 HOPE (Honoring our Professor's Excellence) by SMU. Dr. Cooley's current research interest is to improve our understanding of the universe by deciphering the nature of dark matter. The existence of dark matter was first postulated nearly 80 years ago. However, it wasn't until the last decade that the revolution in precision cosmology revealed conclusively that about a quarter of our universe consisted of dark matter. Dr. Cooley and her colleagues operate sophisticated detectors in the Soudan Underground Laboratory, MN. These detectors can distinguish between elusive dark matter particles and background particles that mimic dark matter interactions.

# DIS2015 Workshop Public Lecture

## Hosted by SMU Department of Physics



If the Universe is the answer...

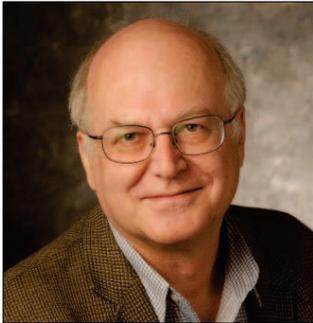
# What is the Question?

Join us for a night of physics questions,  
and some possible paths to answering them.  
We welcome all –  
no tickets or reservations required!

**SUNDAY, 26 APRIL 2015**  
**TIME: 6:30-7:30 PM**  
**LOCATION: SMU Hughes-Trigg Theatre**  
Contact the SMU Physics Department for details  
[www.physics.smu.edu](http://www.physics.smu.edu)  
214-768-2495

Physicist Leon Lederman's famous book, entitled "The God Particle," discussed the important role of the Higgs Boson in our understanding of the universe. Now that the Higgs Boson has been discovered, the subtitle of Lederman's book, "If the Universe is the answer, what is the question?" becomes an important driver for physics research in the coming decades. In this public event, physicists from across the region will each engage the audience with a physics question that they personally believe is critically important to address. What will drive fundamental research into the cosmos? Join us for a night of unanswered questions whose pursuit and answers will change our view of everything.

# DIS2015 Public Lecture Speakers



**Dr. Ryszard Stroykowski** is a professor of physics at Southern Methodist University. His research interests lie in the area of the experimental High Energy Particle physics and the structure of matter. In his early work

he studied the partonic structure of the proton that provided experimental basis for the QCD - the theory of strong interactions. He then studied the properties of heavy quarks in several experiments at electron - positron colliders and led an extended effort to understand the properties of the tau lepton. Since 1996 he has worked on the ATLAS project at Large Hadron Collider and participated recently in the discovery of the Higgs particle. Stroykowski is a Fellow of the American Physical Society, a past member of the Steering Group of the NATO Science for Peace Program and a past Chair of the SMU Physics Department.



**Dr. Chris Jackson** is an assistant professor of physics at the University of Texas at Arlington. His area of expertise is in theoretical high energy physics with particular interests in the phenomenology of the Higgs boson, dark matter and the possible

connection between the two. Dr. Jackson has been lead author on many publications regarding precise predictions of Higgs boson production rates at the Large Hadron Collider. These predictions will play an important role in revealing the true identity of the new particle recently discovered at CERN. Dr. Jackson's research also explores novel theories of dark matter (which makes up 80% of all matter in the Universe!) as well as new and inventive experimental techniques for its discovery. If there is a connection between the Higgs boson and dark matter, the recent discovery at CERN could be a harbinger of "dark forces" to come.



**Dr. Patrick Skubic** is a professor of physics and astronomy at the University of Oklahoma. His area of research is experimental elementary particle physics. And present interest is in experiments at the energy frontier including those that use the world's

highest energy accelerators to study collisions of subatomic particles such as protons. He also has a strong interest in the development of semiconductor detectors for use in high energy physics experiments, and is currently involved in several major efforts in the continued development of these detectors.



**Dr. Stephen Sekula** is an assistant professor of physics at Southern Methodist University. Professor Sekula has made contributions to the study of the newly discovered Higgs Boson's properties, especially its quantum

numbers, and to searches for additional Higgs Bosons in nature. His general research interests include Higgs physics and the larger effort to identify the identity of the major constituents of the cosmos, including Dark Matter. He has been a leader in the Higgs experimental physics community and is an award-winning teacher at SMU.

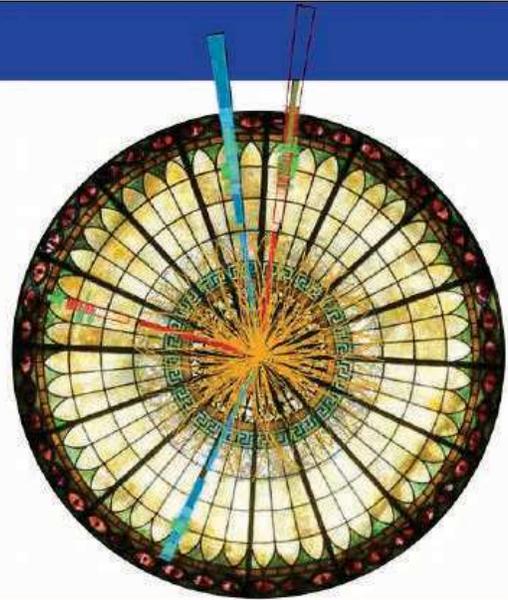
*Please join us for an intriguing evening!*

# SMU Physics Hosts DIS2015 Workshop

## DIS 2015

XXIII International Workshop on  
Deep-Inelastic Scattering and  
Related Subjects

Southern Methodist University  
Dallas, TX, USA, April 27 - May 1, 2015



<http://www.dis2015.org>

The workshop covers wide-ranging topics in theory and experiment, including BNL, CERN, DESY, FNAL, JLab and KEK.

The Physics Department is pleased to host the “2015 International Workshop on Deep-Inelastic Scattering” (DIS2015) on the SMU campus during 26 April to 1 May, 2015. The DIS2015 meeting is the premier international meeting that brings experimentalists and theorists together. This meeting draws approximately 300+ scientists from across the globe to discuss the latest results. Recent meetings were held in Poland, France, Germany, Japan and Russia. Profs. Fred Olness and Pavel Nadolsky chair this effort.

The meeting will kick off on Sunday evening 26 April 2015 with a public lecture entitled “If the Universe is the answer, what is the question.” (See pages 4-5 for details.) During the meeting, the participants will have a chance to tour the downtown Dallas Arts District to enjoy the museums and parks, including the new Klyde Warren park. The conference banquet will be held in our new Perot Museum of Nature and Science.

The meeting is organized by the DIS2015 Physics Program Committee: Abhay Deshpande, Kenichi Hatakeyama, Bob Kehoe, Thia Keppel, Jorge Morfin, Pavel Nadolsky, Fred Olness, Joseph Owens, Jianwei Qiu, Pat Skubic, Karl Wachs, Markus Wobisch, Jae Yu. And this is in coordination with the DIS2015 Local Organizing Committee: Benjamin Clark, Jodi Cooley, Simon Dalley, Ana Firan, Eric Godat, Richard Guarino, Kenneth Harvey, Michele Hill, Bob Kehoe, Florian Lyonnet, Cas Milner, Pavel Nadolsky, Fred Olness, Lacey Porter, Randall J. Scalise, Stephen Sekula, Karl Wachs, Biao Wang



# SMU Physics in the News

**Professor Jingbo Ye** and his team in the SMU Opto-electronics Lab are responsible for the development of optical links for ATLAS Phase-I upgrade, a 4 year project of more than \$2.5 million. This lab sets the speed record in particle physics detector front-end data transmission with the system that reads out the current LAr at a total data rate of about 2.4 Terra-bit-per-second, contributing to the discovery and precision measurement of the Higgs boson. The system SMU will deliver in 2017 is expected to set another record in particle physics for a total data rate of about 25.4 Tbps. R&D work is also conducted in this lab for ATLAS Phase-II upgrade for the High-Luminosity LHC in 2023. Prof. Ye is the Level-II manager in US-ATLAS coordinating R&D work for the Liquid Argon Calorimeter upgrade for the HL-LHC.

**Professor Jodi Cooley** is part of a proposed SuperCDMS at SNOLAB experiment which will be funded by NSF and DOE. This funding provides an opportunity that will allow SMU to continue to play a role as a leader in the field of dark matter physics for the next decade.

**Professor Annie C. Xiang** has received a \$200K DoE R&D award to develop high speed optical transmitters. She also leads the Versatile Link project, a collaboration with CERN, Fermilab, and Oxford.

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In Spring 2014, SMU Physics hosted the **Lightner-Sams Symposium** which drew 200+ attendees to hear about the interface between science and music. In 2015 we are hosting another Symposium on Astrophysics and Cosmology.

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SMU junior and physics major **Nicole Hartman** received the national Goldwater Scholarship. She was among 1,166 students nominated by colleges and universities nationwide for the award, which supports outstanding sophomores and juniors in the sciences, mathematics and engineering. The scholarship offers \$7,500 per year toward tuition, fees, books, and room and board.

A President's Scholar and junior from Lewisville, Texas, Hartman is one of 283 students nationwide to receive the award. She is majoring in physics and mathematics in Dedman College of Humanities and Sciences, and electrical engineering in the Lyle School of Engineering, and is a member of the University Honors Program.

As a Hamilton Undergraduate Research Scholar, she conducts research with Assistant Physics Professor Stephen Sekula and has been investigating the decay of two Z bosons. They are seeking insights into the Higgs boson "God particle," which was observed in 2012 by the global CERN collaboration of thousands of scientists, including SMU physicists.

"I see the awarding of the Goldwater Scholarship as a clear recognition of Nicole's outstanding abilities, and also her strong potential for being a future leader of the field," Sekula said.

Hartman is continuing her research this summer at CERN with Columbia University as part of the National Science Foundation's Research Experience for Undergraduates (REU) program.

"I have amazing professors who make learning so much fun, which is one of the reasons I was motivated to pursue a career in academia," Hartman said. "I know that none of this would have been possible without the amazing support that I've experienced."

# Women in Physics: APS Recognizes SMU



## Highest Fraction of Physics Degrees Granted to Women

### Fraction of Female Undergraduate Physics Degrees: PhD Degree Institutions 2010-2012

Institution	Fraction of Degrees to Women
Bryn Mawr College	100%
Florida Agricultural and Mechanical University	60%
Hampton University	60%
Southern Methodist University	50%
Howard University	50%



## Highest Fraction of Physics Degrees Granted to Women

### Fraction of Female PhD Physics Degrees: PhD Degree Institutions 2010-2012

Institution	Fraction of Degrees to Women
Bryn Mawr College	100%
University of Alabama in Huntsville	80%
University of Denver	67%
University of Texas Hlth Sci Ctr San Antonio	54%
University of Texas at Arlington	50%
Alabama Agricultural and Mechanical University	50%
Georgetown University	50%
Southern Methodist University	50%
Florida Agricultural and Mechanical University	50%

Source: APS/IPEDS

## Undergraduate Researchers on the Frontier!

As in previous years, the Physics Department faculty have been very active in mentoring several undergraduates in cutting edge research projects in particle physics and astrophysics.



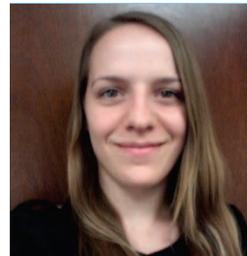
**Matthew Bruemmer's** research is supported by the Hamilton Scholar Program and URA Program. He has researched as an Engaged Learning Fellow with Professors Sekula and Cooley. Matthew focuses on developing a prototype electrostatic shield capable of reducing or preventing the implantation of radon daughters on materials. Radon is ubiquitous, and is of great importance to dark matter and neutrino detection communities because of the need to achieve a very low radioisotope background. Matthew designed and 3-D printed a sample holder for materials used in the study, and he assembled a small chamber prototype to contain this holder. Matthew intends to expose the contained copper, a common detector material, to radon with and without applied electric fields to observe the effect on contamination levels. The current status is being presented at the SMU Research Day, and updates are expected for the Seattle conference and a senior thesis.



**Mayisha Nakib's** research has been supported by the Hamilton Scholar Program, Engaged Learning and URA Program. She continued her work with Professor Jodi Cooley in the study of mitigation of radon in ultra-low background experiments. She focused on reducing or preventing implantation of radon daughters onto detector materials using a nitrogen purged container. She performed calculations on the strength of radon source needed for a clear signal, and is developing a vessel used for controlled radon exposures. The current status of her research is being presented at SMU's annual Research Day in February. She intends to present these results at public professional conferences in Baytown, Texas and Low Radioactivity Techniques conference in Seattle, WA, and in a senior thesis this semester. Mayisha has been supported by SMU's Engaged Learning and Undergraduate Research Assistantships (URA) programs. She and Prof. Cooley received the 2014-15 Texas Section of the APS Hyer Award for outstanding research.



**Nicole Hartman** pursued a URA this year with Prof. Stephen Sekula. She studies how neutrinos from low energy solar p-p reactions interact with electrons in a cold medium, such as liquid neon. This analysis is relevant to potential designs of low temperature liquid noble detectors for future dark matter experiments. They may also be relevant for eventual study of the cosmic neutrino background. She implemented the leading order electroweak interaction diagrams in a simulation using Python, C++ and ROOT. Her preliminary results are being presented at the SMU Research Day.



**Ashleigh Miller's** research is supported by the Hamilton Scholar Program. She was mentored by Research Professor Tiankuan Liu and Ph.D. student Xiandong Zhao in the development of electrical field calculations and multiwire chamber detector response simulations. Ashleigh has mastered the computing environment and software from CERN, and she began using SMU's High Performance Cluster for her studies. The first calculation for a while tube was completed as well as one for a micro-strip gas detector. Current work involves the simulation of the detector response, and the effort is on target for completion this spring semester. Hardware construction will be based on the result of this simulation.

In addition, several other students have been working on ongoing research projects. **Daniel Gum** is mentored by Prof. Robert Kehoe as a Hamilton Scholar on his interdisciplinary project to study gamma-ray bursts by way of optimizing the slew speed of SMU's ROTSE-IIIb robotic telescope. **Christopher Roig** is mentored by Profs. Kent Hornbostel and Math Professor Benno Rumpf in a Mayer Scholars project in chaos. Also, Prof. Tom Coan mentored UT Austin undergraduate **David Dunsky** for a 2nd summer in simulation software development that is relevant for physics course improvements in our curriculum. David wrote visual Python programs in this project to simulate a variety of important electromagnetic processes.

# Dechambeau finds symmetry in physics, college golf

*Excerpt: The following is from the November 19, 2014 edition of Golfweek*



Photo by  
Tracy Wilcox

December 9, 2014  
By Andy Zunz

As of Wednesday, November 19, 2014 **Bryson Dechambeau** could barely turn his neck to see the PowerPoint slides as he elaborated on the finer points of proton decay. That's right, proton decay. Just three days after the SMU junior smoked it 348 yards off the tee to win the Western Refining College AllAmerica Golf Classic long drive contest, he delivered a speech that he prepared for more than a month to 12 students in a particle physics classroom.

Dechambeau, you see, isn't just majoring in golf. He picked physics in order to more intimately learn the mechanics of the golf swing. It's pretty heady stuff for one of college golf's top players but that's the life he leads – a life that includes minors in economics and math too – and it's beginning to catch up to him. A day after his moonshot, Dechambeau ended up withdrawing from the Western Refining College AllAmerica Golf Classic with a strained trapezius muscle.

"Being under a lot of stress with school and playing a lot of golf has all built up and my trap gave out and said 'See you later,'" Dechambeau explained.

Injuries aside, Sir Isaac Newton would certainly approve of how the 21-year-old from Clovis, Calif., with the inquisitive mind is combining his study of physics to become better at hitting a little white ball into a hole.

"Initially, it was because of golf. I loved understanding and figuring out how the golf ball moves through the air, how the dynamic of the golf swing works and how all the different types of motions contribute to the golf swing," Dechambeau said.

Introductory courses turned into upperlevel and even graduate level courses, and now Dechambeau finds

himself studying less practical theory. He's balancing about 16 credit hours per semester with his practice schedule and workout regimen. But his enthusiasm hasn't wavered.

"You never want to tell a kid not to shoot for being great. That's all it is with him. He wants to challenge himself," said SMU head coach Jason Enloe. "He has different interests than a normal college kid. He's trying to gain as much knowledge as he can. For someone of a lesser intellect than Bryson, it might have been tougher, but he's really smart and has the passion."

Mike Schy, who has worked with Dechambeau since the age of 11, said that he'll receive phone calls at 12:30 in the morning, with his student on the other line readying to leave the library.

"His management of his time has to be pretty precise," said Schy. "Honestly, I couldn't imagine doing what he's doing at this point with his golf and his schooling."

...

Part of that learning process included his neck injury on the range in El Paso two weeks ago. Dechambeau said that the stress of school, the ins and outs of traveling and an irregular workout schedule caused the injury. It was all just a matter of time.

Healed and hitting balls again, Dechambeau learned that the route to a higher ranking runs through wins, not top 10s. He plans on lightening his load next summer.

The schedule will change, but Dechambeau's swing will not.

...

"It's a theoretical swing that no one has really done," Dechambeau said. "It's a theory that hasn't really been proven yet, it hasn't been used on the PGA Tour to any extent."

Dechambeau, a proven amateur player having won the 2013 TransMiss Championship and two collegiate tournaments, hopes to change that soon.

"Yes, it's a theory, but it's worked pretty dang well for me so far."

Who's going to argue with a physics major?

Read the full story at: <http://golfweek.com/news/2014/nov/19/bryson-dechambeau-smu-mustangs-college-golf-physic/>

# Eclipsing binary stars discovered by high school students at SMU summer research program

*Posted on August 20, 2014 — Nancy George*

Two Dallas high school students discovered five stars as members of an SMU summer physics research program that enabled them to analyze data gleaned from a highpowered telescope in the New Mexico desert.

All five stars are eclipsing contact binary stars, pairs of stars that orbit around each other so closely that their outer atmospheres touch. As the stars eclipse, they dim and then brighten as one emerges from behind the other. These stars are categorized as variable stars, stars that change brightness, which make up half the stars in the universe.

Lake Highlands High School seniors Dominik Fritz and Jason Barton are the first high school researchers at SMU to discover new stars.

New discoveries in Pegasus and Ursa Major are registered with the Variable Star Index. The stars are located in the northern sky constellations of Pegasus and Ursa Major, but can't be seen by the naked eye.

Their discoveries have been accepted into the American Association of Variable Star Observers International Variable Star Index (VSX).

Working in a campus science building basement laboratory, the students used analysis software, perseverance and patience to parse the data collected (but never analyzed for the purpose of studying binary stars) in 2000 by Robert Kehoe, SMU associate professor of physics.

Kehoe collected the data through ROTSEI, a prototype robotic telescope at Los Alamos, New Mexico.

"Scientists are driven by the sense of discovery," says Kehoe, who took the data originally to study gamma ray bursts. "These students can lay claim to information that didn't exist before their research."

SMU [is the] only university in North Texas offering the nation's QuarkNet program.

Fritz and Barton are among nine high school students and two high school physics teachers conducting physics research at SMU through the QuarkNet program.

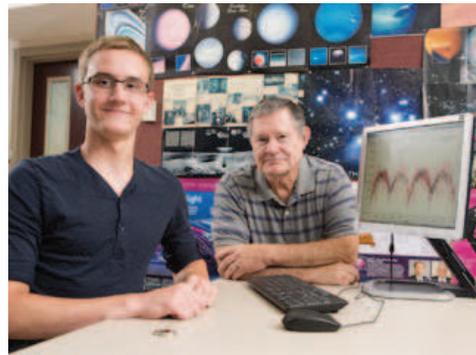
QuarkNet is a physics teacher development program with 50 centers at U.S. universities and national laboratories. Funded by the National Science Foundation and the U.S. Department of Energy, the program gives teachers and students opportunities to learn about the most recent discoveries in physics.

Other sponsors include two of the world's leading highenergy physics research centers — CERN in Switzerland and Fermilab in Illinois. SMU is one of four Texas universities to offer the QuarkNet program and the only QuarkNet university in North Texas.

"High school physics curriculum includes very little modern physics," says Simon Dalley, a member of the SMU physics faculty and coordinator of its QuarkNet program. "This hurts recruitment to the field and prevents the general population from understanding physics' contribution to the modern world."

Ken Taylor, Lake Highlands High School physics teacher, is determined to introduce new physics research to his students. He has participated in QuarkNet at SMU since 2000, seizing opportunities to join physics researchers at highenergy particle colliders at CERN and Fermilab. This is the first summer he has selected students to join him in physics research at SMU.

"I like to support students beyond the classroom walls," he says. "These students have gone through the whole process of scientific discovery and can use these projects as jumping off points for the next phases of their lives."



Lake Highlands High School student Dominik Fritz and teacher Ken Taylor at SMU. Fritz participated in Quarknet, an SMU Physics Department program for area high school students.

With acceptance into the VSX catalog of variable stars, the students' names are forever linked with their stars on the official registry.

But instead of creating new star names, star discoverers follow a protocol that includes the name of the telescope and the stellar coordinates.

Dominik Fritz discovered ROTSE1 J115128.40+493130.5, ROTSE1 J120809.03+503321.7 and ROTSE1 J232109.31+170125.6. Jason Barton can include his stars, ROTSE1 J223452.37+175210.5 and ROTSE1 J223707.20+212657.9, on his resume.

Both students plan to pursue science careers, Fritz in nuclear engineering and Barton in medicine.

Other student QuarkNet researchers include KeShawn Ivory from Garland High School and Madison Monzingo and Lane Tounge from Lake Highlands High School. In addition, Hockaday School teacher Leon de Oliveira and his four students — Eliza Cope, Allison Aldrich, Sarah Zhou and Mary Zhong — also conducted QuarkNet research this summer.

"These students have made a real contribution to science," says Farley Ferrante, the former high school physics teacher and current SMU astrophysics graduate student who supervised the students' research. "A better understanding of variable stars helps us to understand the age and formation of the universe; the sun, which is a variable star; and even the possibility of extraterrestrial life."

# KERA: Telescope-Wielding Twosome: High School Students Discover New Stars

Posted on September 5, 2014

Reporter Courtney Collins with the news team at public radio station KERA covered the discovery of five stars made by two Dallas high school students as members of an SMU summer physics research program. Called Quarknet, the program enabled the students to analyze data gleaned from a high-powered telescope in the New Mexico desert.

All five stars are eclipsing contact binary stars, pairs of stars that orbit around each other so closely that their outer atmospheres touch. As the stars eclipse, they dim and then brighten as one emerges from behind the other. These stars are categorized as variable stars, stars that change brightness, which make up half the stars in the universe.

Lake Highlands High School seniors Dominik Fritz and Jason Barton are the first high school researchers at SMU to discover new stars.

Fritz and Barton are among nine high school students and two high school physics teachers who conducted physics research at SMU through the QuarkNet program.

Collins' segment published and aired Sept. 4, "Telescope-Wielding Twosome: High School Students Discover New Stars."



*Lake Highlands High School students Dominik Fritz (right) and Jason Barton collected data until they had what they needed to define their star-to-be as a variable — a star that changes brightness.*

EXCERPT:

By Courtney Collins, KERA News

*To most teenagers, stargazing is the stuff of first dates.*

*For two seniors at Lake Highlands High School in Dallas, stargazing over the summer led to five unusual discoveries.*

*In some respects, Dominik Fritz and Jason Barton are typical highschoolers. Jason's haircut would make a pop star envious and Dominik's snazzy specs are effortlessly cool.*

*When these two kids start to talk science, you realize quickly, they're two in a million.*

*"I'm personally fascinated by nuclear reactions and that's basically what happens in stars, it's full of nuclear reactions, nuclear fusion, a little bit of fission," Dominik says.*

*That set of interests made Dominik a perfect candidate for a summer physics program at SMU. Jason and two other Richardson school district students joined him.*

*While analyzing data from a highpowered telescope, Jason noticed a few stars that weren't already in the database.*

*"I started looking over several nights and seeing if they were actual variable stars and if they did change in brightness over time, and then I combined them all and then I eventually submitted it," Jason says.*

*In fact, both teens made submission to an international star index that were accepted. Between them, they'd discovered five eclipsing binary contact stars. Dominik translates:*

*"Two very, very large star systems that are so close that they actually share their atmospheres."*

*Lake Highlands physics teacher Ken Taylor says not many kids make it to upper level physics. That's why he was so keen to get these students out of the textbook and into real research.*

*"It was beautiful for me to see my students who were going and forging ahead and taking things that they had learned and going into new territory and seeing the looks on their faces when they began to go somewhere where, in a sense, no one had gone before."*

# From the Standard Model to Space

A group of scientists who started at particle physics experiments move their careers to the final frontier.

By Glenn Roberts Jr., *Symmetry Magazine*



As a member of the ATLAS experiment at the Large Hadron Collider, **Ryan Rios** spent 2007 to 2012 surrounded by fellow physicists.

Now, as a senior research engineer for Lockheed Martin at NASA's Johnson Space Center, he still sees his fair share.

He's not the only scientist to have made the leap from experimenting on Earth to keeping astronauts safe in space. Rios works on a small team that includes colleagues with backgrounds in physics, biology, radiation health, engineering, information technology and statistics.

"I didn't really leave particle physics, I just kind of changed venues," Rios says. "A lot of the skillsets I developed on ATLAS I was able to transfer over pretty easily."

The group at Johnson Space Center supports current and planned crewed space missions by designing, testing and monitoring particle detectors that measure radiation levels in space.

Massive solar flares and other solar events that accelerate particles, other sources of cosmic radiation, and weak spots in Earth's magnetic field can all pose radiation threats to astronauts. Members of the radiation group provide advisories on such sources. This makes it possible to warn astronauts, who can then seek shelter in heavier-shielded areas of the spacecraft.

Johnson Space Center has a focus on training and supporting astronauts and planning for future crewed missions. Rios has done work for the International Space Station and the robotic Orion mission that launched in December as a test for future crewed missions. His group recently developed a new radiation detector for the spacestation crew.

Rios worked at CERN for four years as a graduate student and postdoc at Southern Methodist University in Dallas. At CERN he was introduced to a physics analysis platform called ROOT, which is also used at NASA. Some of the particle detectors he works with now were developed by a CERN-based collaboration.

Fellow Johnson Space Center worker Kerry Lee wound up a group lead for radiation operations after using ROOT during his three years as a summer student on the Collider Detector at Fermilab, or CDF experiment.

"As a kid, I just knew I wanted to work at NASA," says Lee, who grew up in rural Wyoming. He pursued an education in engineering physics and "enjoyed the physics part more than the engineering." He received a master's degree in particle physics at Texas Tech University.

A professor there helped him attain his current position. "He asked me what I really wanted to do in life," Lee says, "and I told him, 'NASA.'" He worked on data analysis for a detector aboard the robotic Mars Odyssey mission, which flew in 2001. "The tools I learned at Fermilab for data analysis were perfectly applicable for the analysis on this detector," he says. One of his most enjoyable roles was training astronauts to use radiation-monitoring equipment in space.

"Every one of the crew members would come through [for training]," he says. "Meeting the astronauts is very exciting—it is always a diverse and interesting group of people. I really enjoy that part of the job."

Physics was also the starting point for Martin Leitgab, a senior research engineer who joined the Johnson Space Center group in 2013. As a PhD student, Leitgab worked at the PHENIX detector at Brookhaven National Laboratory's Relativistic Heavy Ion Collider. He also took part in the Belle Collaboration at the KEK B-factory in Japan. A native of Austria who had attended the University of Illinois at Urbana-Champaign, Leitgab says his path to NASA was fairly roundabout.

"When I finished my PhD work I was at a crossroads—I did not have a master plan," he says. He says he became interested in aerospace and wrote some papers related to solar power in space. His wife is from Texas, so Johnson Space Center seemed to be a good fit.

"My job is to make sure that the detector built for the International Space Station works as it should, and to get data out of it," he says. "It's very similar to what I did before... The hardware is very different, but the experimental approach in testing and debugging detectors, debugging the software that reads out the data from the detectors and determining the system efficiency and calibration—that's pretty much a one-to-one comparison with high-energy physics detectors work."

Leitgab, Lee and Rios all say the small teams and tight, product-driven deadlines at NASA represent a departure from the typically massive collaborations for major particle physics experiments. But other things are very familiar: For example, NASA's extensive collection of acronyms.

Rios says he relishes his new role but is glad to have worked on one of the experiments that in 2012 discovered the Higgs boson. "At the end of the day, I had the opportunity to work on a very huge discovery—probably the biggest one of the 21st century we'll see," he says.

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## Beal Bank Dallas Regional Science & Engineering Fair

SMU sophomore engineering major Micah Thornton credits his seventh grade participation in the 2007 Beal Bank Dallas Regional Science and Engineering Fair as a life-changing event. He set his sights on a science and engineering career after winning second place in the computer science division of the fair.



*2014 Grand Prize winning students. Those in senior division are offered a scholarship to attend SMU.*

Nearly 1,000 other students their had their lives changed Feb. 21, 2015, when they participated in the annual Beal Bank Dallas Science and Engineering Fair at Fair Park. Sixth through 12th grade students whose projects won their school science fairs competed for more than 500 awards. SMU Physics coordinates the fair and SMU also hosts the March banquet honoring the top 150 fair winners, their parents and science teachers.

Micah Thornton attended that banquet in 2007, and started SMU in 2012. By his third week of Simon Dalley's Introductory Mechanics class last fall, he realized why Dr. Dalley looked familiar. "My participation and success in the science fair as a 7th grader in 2007 was one of the things that put me on my current path as an engineering student," Thornton wrote to Dalley in an e-mail. "It didn't hit me until about the third week of class that you were the director of the fair. I've always wanted to thank the person in charge. Your work with the science fair affects so many people, and in case you don't hear it enough – thanks."



The science fair directors are **Simon Dalley**, **Fred Olness**, **Randall Scalise**, and **Nicholas Tsarevsky** (SMU Chemistry). This article is abridged from a press release by Nancy George (SMU Public Affairs).

For more information about the fair visit: <http://dallasciencefair.org/>



# SMU Hosts Master Physics Teacher Certificate Program

SMU Physics department faculty propose to systematically strengthen the physics content of existing career science teachers who have a specialization other than physics but who are or will be teaching physics. A one-year 3-module course specifically developed for the needs of science teachers in this position implies a large increase in training efficiency over newly qualified physics graduates. High school students benefit from a wider availability of teachers adequately prepared in subject content.



SMU faculty from Physics and from Education, together with a Teacher-In-Residence, delivered the three modules of the certificate program: Mechanics (Fall 2013); Electromagnetism (Spring 2014); Modern Physics (Summer 2014). 19 DFW-area science teachers completed one or more modules during the academic year and 7 of those were able to complete all 3

modules within the year and were awarded the MPTC. Several of these graduated with distinction and were invited into our QuarkNet program.

The MPTC program received donations during the year from the Hoglund Foundation and from the Fluor Foundation. In addition to Dedman College shouldering the Facilities & Administration costs, the Physics Department provided for miscellaneous off-budget items, such as providing dinner to participants in the evening classes.

The contributors to the 2013-14 program were:

- Dr. Simon Dalley (certificate and module leader)
- Dr. Randall Scalise (module leader)
- Farley Ferrante (teacher-in-residence)
- Dr. Jodi Cooley (module instructor)
- Dr. Steven Sekula (module instructor)
- Dr. Andy Liu (module instructor)
- Prof. Rick Guarino (lab manager)
- Dr. Dara Williams-Rossi (certificate advisor and module instructor)

For more information about the MPTC go to <http://www.smu.edu/Dedman/Academics/Programs/MasterPhysicsTeacherCertificate>

# SMU Physics Summer QuarkNet Program

SMU Physics group had its annual QuarkNet center activities in summer 2014 for local high school physics teachers and students. The week of August 4-8 held the workshop and there were summer-long research projects. This year there were 19 teachers from Dallas area public and private schools at the workshop while 2 teachers and 8 students performed summer research in SMU labs. A feature of the workshop this year was a joint day at SMU with 10 more physics teachers and 30 students from the UT Southwestern STARS program.



During the workshop, teachers heard talks on the latest research from SMU professors Tom Coan (NOvA/neutrinos) and Steve Sekula (Standard Model and Beyond). They viewed the new documentary Particle Fever and had a discussion with Prof. Fred Olness about the background to its making. After a discussion about polarization and vacuum condensates, teachers also watched a seminar on YouTube given by the BICEP-2 collaboration on the recent results concerning gravity waves in the early universe. This tied in with the group's trip

to LIGO 2 years ago. During the afternoons the teachers constructed several make-and-take demos that they had seen in the classrooms during their trip to LIGO. Teachers Julia Porowski, Tammy McDaniel, Tim Graves, Nathan Brown, Bruce Boehne, and Evelyn Restivo each led a presentation or activity they had brought. Teacher Kevin Cieszkowski presented on the SuperCDMS-Dark Matter research work he did with SMU Professor Jodi Cooley during the summer; he designed and constructed from a pressure cooker a simple storage container to prevent radioactive contamination.

Leon DeOliveira and 4 of his high school students spent the summer doing research in the SMU Physics Department's Opto-Electronics lab, working with physicists Datao Gong and Di Guo on the optical data link updates for the ATLAS LAr Calorimeter. Working with SMU graduate student (and former QuarkNet teacher) Farley Ferrante, Ken Taylor and 4 of his high school students analyzed virgin data from SMU's ROTSE telescope located at the McDonald Observatory in West Texas. The students discovered 5 new variable stars and were featured in a Dallas Morning News article and on KERA. The summer research students and teachers participated in weekly departmental lunch seminars and presented their findings at the QuarkNet workshop.

*The 2014 program was organized by Simon Dalley (center director and mentor), Randall Scalise (mentor), Fred Olness (mentor), and Rick Guarino (mentor).*

# Nakib and Cooley Receive Hyer Research Award

Dear Ms. Nakib and Professor Cooley,

It gives me great pleasure to inform you that you have been selected to receive the 2014 Hyer Research Award of the Texas Section of the American Physical Society. (<http://www.aps.org/units/awards/hyer/>)

Ms. Nakib, on Saturday evening at the banquet of the APS Texas Section meeting you will be presented with a \$500 check. Further, both you and Professor Cooley will each be presented an award plaque for your contribution to the search for dark matter being conducted in the program Super Cryogenic Dark Matter Search.

A requirement for the award is that you both must be members of the American Physical Society. Please join APS immediately if you are not already a member: <https://www.aps.org/memb-sec/>

I look forward to meeting and congratulating you at the banquet on Saturday.

Sincerely,

Harry L. Swinney

Sid Richardson Foundation Regents Chair

Physics Dept., U. Texas at Austin

for the Hyer Award Committee:

Jennifer Steele (Trinity U)

Tim Head (Abilene Christian U)

Harry Swinney (UT-Austin)

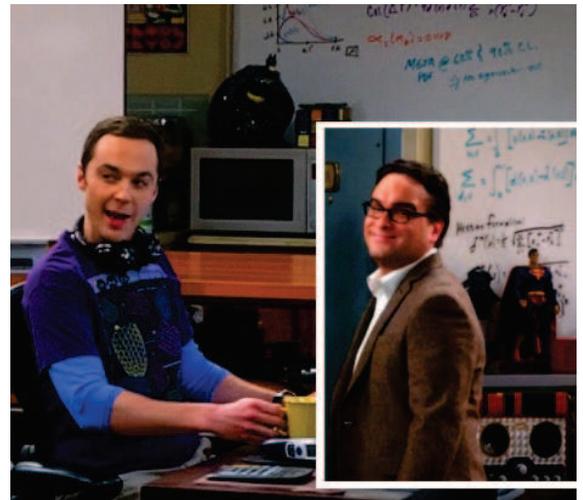
*Each recipient will receive a plaque, and the student recipients additionally will receive \$500 each. Awards will be presented at the Fall meeting.*

The Robert S. Hyer Research Award, of the Texas Section of the American Physical Society, will be presented each year to two pairs of recipients. The first pair will consist of a recipient who must have been a graduate student when the research was performed, and this student's research advisor. The second pair will consist of a recipient who must have been an undergraduate student when the research was performed, and that student's research advisor. The only criterion is excellence, including potential impact in the relevant scientific community. The research must be in physics or a physics-related subject, and it must have been presented at a Texas APS meeting within the past two years by either the student or the advisor, both of whom must have been TSAPS members at the time. Nominations for the award, including a maximum of three letters of support (in addition to the nomination letter), can be submitted either before or after presentation of the research at a Fall or Spring TSAPS meeting. Normally all recipients must be in attendance when the award is presented to them. Also, the award will normally not be given in two consecutive years to recipients at the same institution. Nominations will remain active for two years, or until no longer eligible. The Executive Committee will name a 3-person awards committee to choose the recipients each year. The conditions for the presentation of the award will be decided by the Executive Committee.

## Physics in Pop Culture

Formulas and equations fill the day of a particle theorist. So many ideas can be stated in the language of math! Profound equations can convey an acute feeling of beauty. A whiteboard with an insightful derivation may feel a bit like a sketch art.

It is fun to see your equations make a way into art, too. In the popular sitcom "Big Bang Theory" about physicists, whiteboards are used both as a backdrop for acting and to showcase pertinent ideas from various branches of science. A recent episode of the sitcom, "Anxiety Optimization", features notes about a recent "meta-analysis of parton distributions" published by SMU physicists Jun Gao and Pavel Nadolsky. Parton distributions are widely used to describe the internal structure of protons in theoretical predictions for the Large Hadron Collider. They are determined in a multi-faceted "global analysis" of particle 'big data' that involves state-of-the-art theoretical computations and advanced statistical methods. The meta-analysis developed by the SMU group is considered for future LHC runs. The parton distributions are the staple input for the LHC physics program and apparently have even caught the choosy eye of Sheldon Cooper.



# 2014-2015 Physics Student Awards

## Fall 2014 Undergraduate Awards

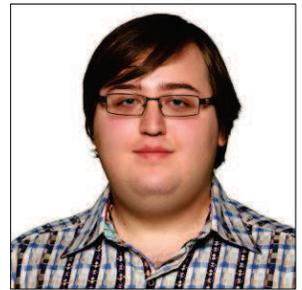
### Hyer Awards:



**Mayisha Nakib** is currently a senior Dedman College Scholar majoring in Physics, Pure Mathematics, and Biology. She has worked with Professor Jodi Cooley since freshman year

on radon plateout studies and background studies for dark matter searches. After graduation, she plans on pursuing a PhD in physics.

**Rafael Sierra** – Born and raised in Canada before immigrating to the States, Rafael has always maintained a passion for the sciences. He majors in Mathematics and



Physics, currently researching hyper-complex numbers and their applications to Physics. With an unbending love of knowledge, Rafael plans to become a Theoretical Physicist and demystify the deepest questions of nature.

*The Hyer Award was established in honor of SMU's first president Robert S. Hyer.*

### McDonald Award

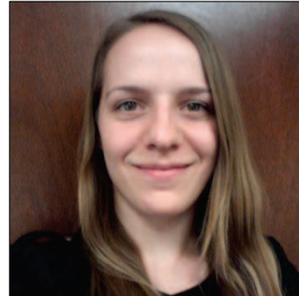


**Matthew Bruemmer** was born in Chicago, IL, moving every two years until settling in to San Antonio, TX at the age of 13, where he actively pursued science, music, and sports. He is

majoring in Mechanical Engineering and Physics with a minor in Mathematics, and does research in the Lumina lab looking at how to reduce background for dark matter experiments like SuperCDMS. Matthew has accepted a full time position at Texas Instruments after he graduates in May, where he will be working as a Manufacturing Engineer improving physical processes of making semiconductors.

*In memory of Frank C. McDonald, Chair of the Physics Department 1941-1962.*

### Wiley Scholarship Award



**Ashleigh Miller** was born and raised in a small town in East Texas. Her love for science stemmed from her passion for space exploration at a young age. She has a major in physics and is

currently doing research on particle detector prototypes in the SMU Opto-electronics lab. Passionate about the mysteries of the universe and what lies beyond the horizon of deep space, Ashleigh plans to pursue a research career that focuses on bringing mankind closer to exploring space beyond our solar system.

*Made possible by The Katherine Sams Wiley Physics Scholarship Endowment Fund*

## Spring 2015 Undergraduate Awards

### Chalk Award

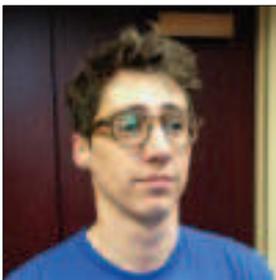


**Nicole Hartman** is a junior from Lewisville, TX majoring in physics, math, and electrical engineering. She's currently doing research in particle physics with Dr. Sekula investigating the feasibility of tracking the sun with neutrinos, and after graduation, she hopes to attend grad school to study experimental particle physics.

*Made possible by the Chalk Scholarship Award for Excellence in Physics*

## 2014 William (Bill) Tittle Graduate Awards

This award is named in honor of former Physics Professor & Chair, Bill Tittle, and it provides support for graduate students for travel to conferences and workshops. The 2014 Tittle Awards included support for graduate students **Ben Clark** to attend Mcnet School; **Eric Godat**, **Ryan Staten**, **Andrew Turvey** to attend Fermi School.



**Ben Clark** was born in San Antonio, Texas. He is currently pursuing a PhD in Theoretical Physics with a focus on Parton Distribution Functions. After graduating, he plans

on securing a position as a post-doctoral researcher.



**Andrew Turvey** hails from the plains of Kansas. Growing up on an 80-acre farm with an expansive shop allowed for him to tinker with all things mechanical. With his love

for being in a shop and the desire to understand the fundamental laws of nature, experimental physics was a natural fit. Andrew completed a B.S. in Physics from Pepperdine University and currently is continuing his graduate studies where he is a part of SMU's ATLAS group.



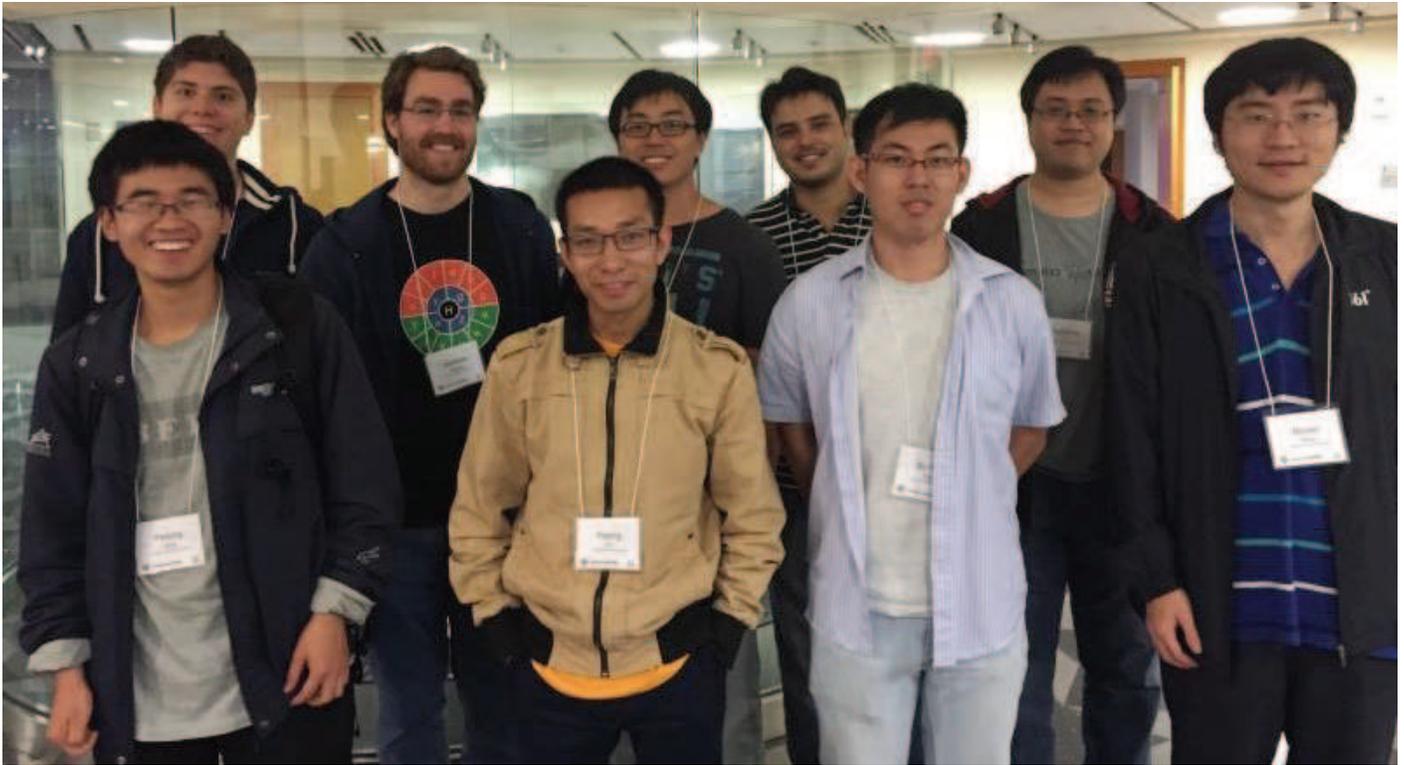
A Dallas native, **Eric Godat** received his Bachelor Degree in Physics and Mathematics at Southwestern University. Having received his Masters from SMU this past December, he is now a

full time PhD candidate in particle phenomenology working on Parton Distribution Functions. After getting his PhD, Eric would like to follow his passion for teaching by becoming a professor.



Originally from Texas, **Ryan Staten** was an undergraduate at Southwestern University where he majored in Physics and minored in Mathematics and French.

Now, as a graduate student, he works with Bob Kehoe, studying the death of massive stars and their application to the universe and dark energy.



**Fall 2014 Joint Meeting of the Texas Section of the American Physical Society  
at Texas A&M University in College Station, Texas.**

*Back row, left to right: Grant Meadows, Matthew Feickert, Li Zhou, Govinda Dhungana, HuanZhao Liu*

*Front row, left to right: Peilong Wang, Keping Xie, Bo-Ting Wang, Bowen Wang*

### ***Thank you for Keeping in Touch!***

Thanks to all who updated their contact information for our records. You can find recent news on our webpage. We request that you:

- Inform us of any address changes so that we may keep in contact in the future
- 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

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