PHYSICS AT SMU

Inside this Edition

SPRING 2021

CREDITS

Administrative Staff

Lacey Breaux

Michele Hill

Prof. Jodi Cooley, Chief Marshal of the University, leads new students to the Dallas Hall Rotunda for the January 2021 Convocation ceremony.

About the Administrative Staff

Lacey Breaux *joined the department in July of 2014 and is the lead for Academic Operations. She is pursuing an M.Ed. of Higher Education Administration at SMU with emphasis on doctoral student advising and mentoring, and science education policy.*

Michele Hill *joined the department in October of 2014 and is the lead for Research Operations. She serves on the SMU Staff Association's Executive Board as Vice President of Programming.*

Department Leadership

Chair:
Stephen Sekula

Associate Chair for Graduate Studies:
Fred Olness

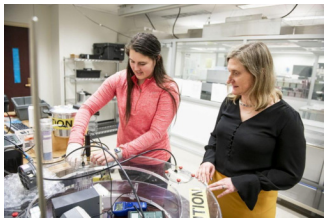
Assistant Chair for Undergraduate Studies:
Simon Dalley

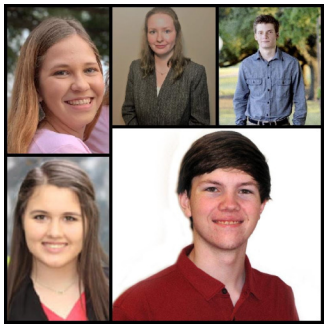
On the Cover

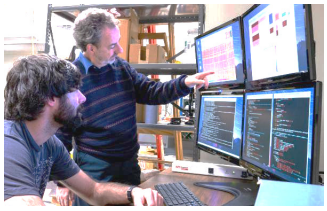
Front Cover: *The Dallas Hall oculus blends into a particle collision event display from the ATLAS Experiment at the Large Hadron Collider and a quadrant of the spiral galaxy M101. These symbolize our department's twin research efforts in particle physics and astrophysics/cosmology.*

Back Cover: *The Dallas Hall oculus blends into the ceiling of the Gail and Gerald Turner Pavilion. The pavilion stands behind the Blanton Building and its ceiling is painted to look like a night sky near dusk as stars emerge from behind the fading light of sunset.*

Table of Contents







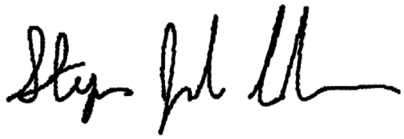
Message from the Chair

This has been a truly unique year. On that, I think, we can all agree. There have been challenges. There have been opportunities. Through all of this, we have been driven by our twin missions of research and teaching.

Let's first look at some amazing things. We saw three doctoral students earn their Ph.D.s in 2020. We welcomed our newest faculty member, Assistant Professor Krista Lynne Smith, who brings to our program expertise in the study of galaxies and supermassive black holes. We supported and celebrated students who earned summer research fellowships at prestigious university programs outside SMU and who earned competitive international scholarships. We welcomed the largest doctoral candidate class in over a decade. We celebrated our Society of Physics Students chapter attaining "Outstanding" (top 15%) designation from the national organization. It's a matter of public record that our department attracted $3 million in external research funding in 2020, 61% of which was directed toward particle physics and 39% was directed toward astrophysics and cosmology. Looked at in this way, we had a good year.

Obviously, all of this was embedded in one of the most challenging times in a century. Faculty and students generally couldn't be in the same room during teaching and research activities, and when they could it was 6-feet apart and masked. The joy of being in-person and engaging with your audience in teaching, during a colloquium or seminar talk, was gone. Coffee breaks were virtual. There were no casual interactions with colleagues or students in hallways. The hallways were empty, marked with blue tape to indicate flow during high-traffic periods (of which there have been none since March 2020), and we all learned to live off our calendars and Zoom.

Which, when you think about it, makes the accomplishments of faculty, post-doctoral researchers, staff, and students even more remarkable. I welcome your engagement with these achievements, dear reader, as you flip through the pages of this newsletter and learn all that was accomplished.



Stephen Jacob Sekula
Chair, Department of Physics

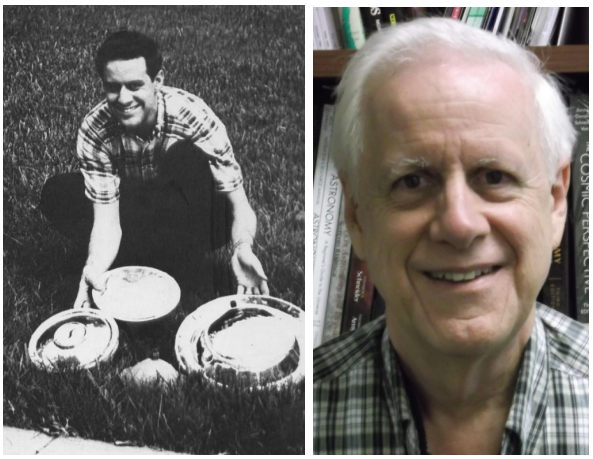
The Department Speaker Series Presents …

Distinguished Professor Pierre Ramond
(University of Florida)
"The Unfinished Standard Model"
The Spring Colloquium

Monday, May 3, 2021 - 4-5pm

Prof. Pierre Ramond, founder of Superstring Theory, Distinguished Professor of Physics at the University of Florida, and co-recipient of the 2020 Dirac Medal and Prize, will present the final colloquium of the Spring 2021 Speaker Series. We welcome all members of the SMU Physics Community to join us virtually (online-only) for this event. Please RSVP for the connecting information.

RSVP: https://tinyurl.com/SMUPhysicsMay3
SAVE THE DATE!



Prof. John Cotton, then and now.

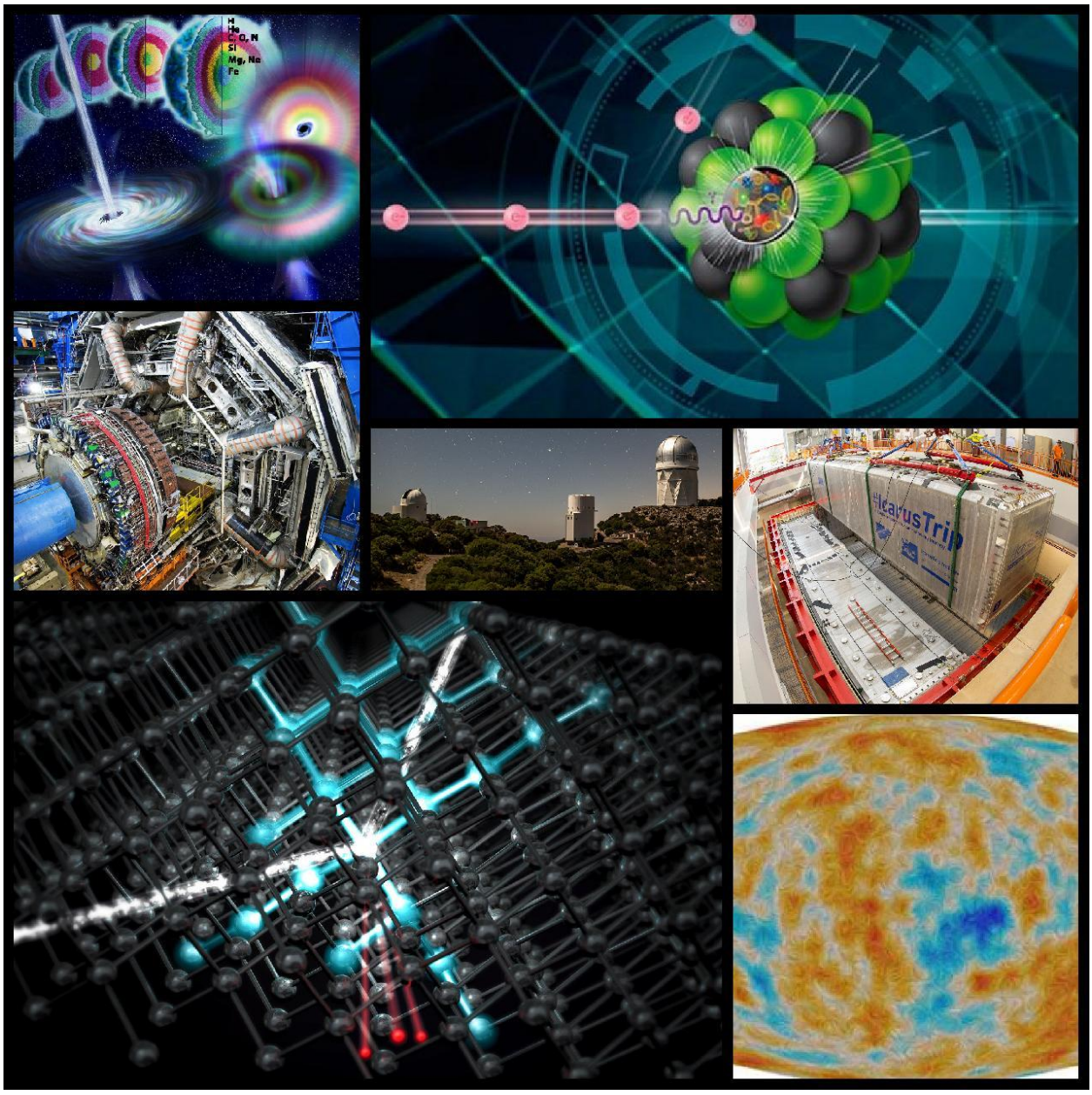
A Look Ahead to Fall 2021 …

"Cotton Bowl"

In the fall of 2021 we plan to host a special one-night symposium to celebrate the life and career of Prof. John Cotton, who recently retired from teaching in our department. For decades, Prof. Cotton taught our introductory course on astronomy and co-invented and taught the "Introduction to the Scientific Method" course. He is beloved by colleagues and students alike. We are eager to celebrate his life and achievements together with our physics community.

Watch for more information about this event by signing up for our community mailing list (*see pg. 34*) or following our **Friday Physics Newsletter** at https://blog.smu.edu/smuphysics

Spotlight on Research



A Song of Supermassive Black Holes

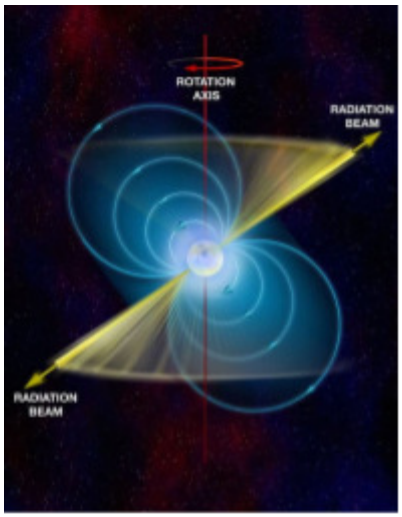
By Joel Meyers, Assistant Professor of Physics

Green Bank Telescope (credit: NRAO)

William E Gordon Telescope / Arecibo Observatory (credit: UCF/AO)

The NANOGrav (North American Nanohertz Observatory for Gravitational Waves) collaboration recently published the results of a search for stochastic background of low frequency gravitational waves based on 12.5 years of data. For the first time, the analysis of this type of data has shown an intriguing hint of a non-zero signal that is roughly consistent with that expected from the gravitational waves produced by the coalescence of supermassive black holes throughout the Universe. The signal is not yet significant enough to definitively claim that it represents a detection of a long-wavelength gravitational wave background, though future data from NANOGrav and similar efforts should be decisive within the next few years.

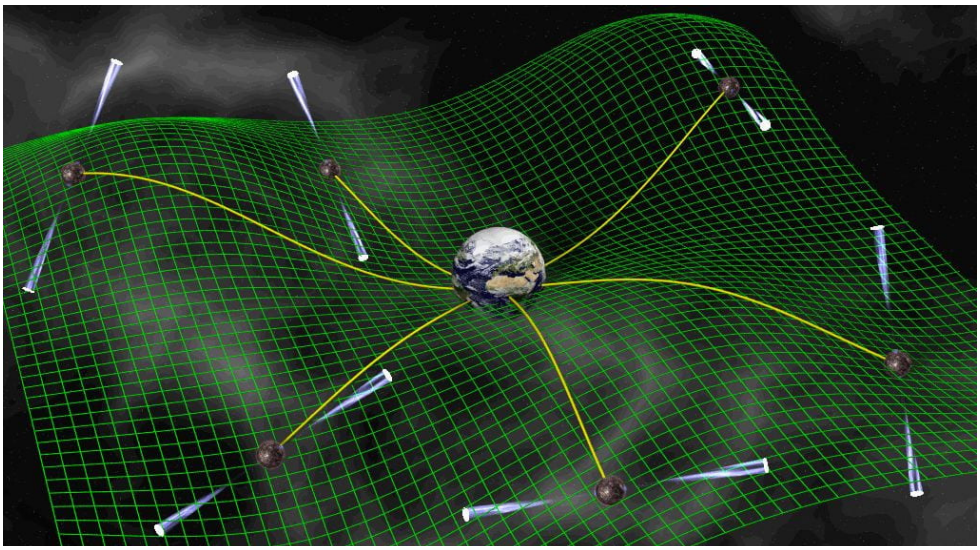
NANOGrav is a type of a coordinating observing campaign known as a Pulsar Timing Array. NANOGrav scientists use the Green Bank Telescope in West Virginia and the Arecibo Observatory in Puerto Rico (until its shocking recent collapse captured in a stunning video) to monitor the very regular radio pulses from astrophysical objects known as pulsars situated throughout the Milky Way Galaxy. Pulsars are very rapidly spinning neutron stars that host strong magnetic fields which cause beamed emission from their poles. Observers here on Earth see pulsar emission only when the radiation is beamed toward us, much like the light from a lighthouse is seen by sailors only when the beam illuminates their ship, and as such pulsars appear to undergo regular bursts of radio emission. The extreme regularity of these radio pulses allows scientists to use pulsars as very precise clocks spread throughout the Galaxy. Pulsar timing arrays are used to monitor the radio bursts from many pulsars over several years, and scientists look for



Pulsars as spinning neutron stars (Credit: Bill Saxton, NRAO/AUI/NSF)

tiny deviations in the expected pulse arrival times. (For an excellent overview of Pulsar Timing Arrays and NANOGrav, see the recent SMU Physics seminar by Dr. Stephen Taylor[1].)

Gravitational waves passing through the Earth stretch and squeeze space, effectively altering the light travel time between distant pulsars and the Earth. As a result, gravitational waves are expected to produce a correlated shift in the arrival times of radio pulses from pulsars. The nature of gravitational waves predicts a specific ("quadrupolar") pattern of correlation. While the data from NANOGrav has demonstrated that there is a correlated shift to the pulse arrival times, the signal is not yet strong enough to demonstrate that it has this characteristic pattern. More observing time and correlation with other pulsar timing arrays (including the Parkes Pulsar Timing Array in Australia and the European Pulsar Timing Array) should make it possible to either confirm or rule out the signature correlation pattern expected from gravitational waves.

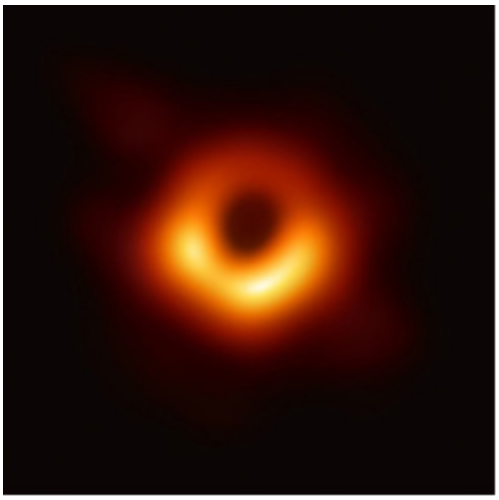


Pulsar Timing Array (Credit: D. Champion)

Pulsar timing arrays are sensitive to very low-frequency gravitational waves, with periods on the order of a year. This frequency range cannot be directly probed with experiments like LIGO and VIRGO, which are sensitive to higher frequency gravitational wave signals. Pulsar timing arrays are currently the most precise tools we have to search for nanohertz gravitational waves, but there are other techniques that can complement the ongoing efforts. Gravitational waves cause a characteristic oscillation in the apparent positions of distant stars, and so very precise astrometric measurements provided by experiments like Gaia can be used to search for long wavelength gravitational waves. A novel method using observations of strongly lensed repeating fast radio bursts (for more about fast radio bursts, see

[1] "New Results from the Pulsar Timing Array Hunt for Nanohertz-Frequency Gravitational Waves". Stephen Taylor. SMU Physics Speaker Series. November 9, 2020. https://www.youtube.com/watch?v=5TAo4M1di6o

recent SMU Physics Seminar by Kendrick Smith) has also recently been suggested by SMU physicists: undergraduate Noah Pearson, postdoc Cynthia Trendafilova, and Professor Joel Meyers[2].



M87 (Credit: Event Horizon Telescope)*

Gravitational waves in the nanohertz band are expected to be produced by binary systems of supermassive black holes that are expected to form as the result of major galaxy mergers throughout the Universe. There are expected to be so many of these events that the Universe should constantly be filled with the low hum of the gravitational waves produced in this process – a stochastic gravitational wave background.

Supermassive black holes have been featured prominently in the news in the past few years. In 2019, the Event Horizon Telescope collaboration produced an image of the environment of the supermassive black hole at the center of the M87 galaxy. The 2020 Nobel Prize in Physics was awarded in part for the observations that confirmed the presence of a supermassive black hole at the center of the Milky Way. Results like those from NANOGrav add to the growing list of ways that we can study these astrophysical behemoths. Astrophysicists including SMU Professor Krista Lynne Smith use these and other measurements to study supermassive black holes and the effects they have on their host galaxies (see Professor Krista Lynne Smith's recent SMU Physics Colloquium[3]).

If the signal seen in NANOGrav data is confirmed to be due to gravitational waves, it will provide an important new piece of information about the population and history of supermassive black holes. Furthermore, it provides an additional example of how gravitational wave observations can be utilized to reveal the secrets of our Universe.

Prof. Joel Meyers is an Assistant Professor of Physics at SMU and an expert in theoretical cosmology and astrophysics. In addition to his research, he teaches a range of courses from Introductory Physics through graduate-level Quantum Field Theory. He joined the faculty at SMU in 2018.

[2]Pearson, N., Trendafilova, C., and Meyers, J. "Searching for Gravitational Waves with Strongly Lensed Repeating Fast Radio Bursts". https://arxiv.org/abs/2009.11252

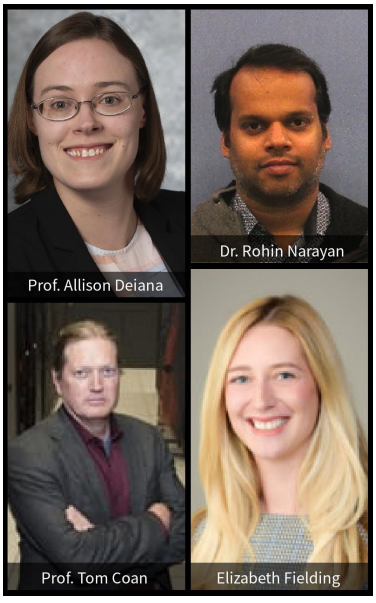
[3] "Feeding the Monster: Supermassive Black Holes and the Galaxies They Inhabit". Krista Lynne Smith. SMU Department Speaker Series. December 6, 2020. https://www.youtube.com/watch?v=n4IASWjyZlU

SMU Hosts Workshop on Fast Machine Learning for Science

A four-day event, “Fast Machine Learning for Science”, was hosted virtually by Southern Methodist University from November 30 to December 3. The first three days were workshop-style with invited and contributed talks. The last day was dedicated to technical demonstrations and coding tutorials.

The workshop is the latest in an ongoing series, the previous of which was held at Fermi National Accelerator Laboratory in 2019. SMU’s increased support for and visibility in high-performance computing, combined with the expertise in the physics department, made our institution an ideal host for the 2020 workshop. We are extremely grateful to the scientific organizing committee for the chance to host this event. The workshop was locally organized by Prof. Tom Coan, Prof. Allison Deiana, Dr. Rohin Narayan, and the coordinator for the Dedman College Interdisciplinary Institute (DCII), Elizabeth Fielding.

The workshop was a great success, even in the face of challenges from the ongoing COVID-19 pandemic. The event drew up to 282 individual daily attendees. The fourth day consisted of two hands-on tutorial sessions with the HLS4ML package and had nearly 100 people in attendance. The organizational success was especially made possible with the support of the DCII. The scientific success was driven by the participants, especially the excellent speakers and tutorial leaders, many of whom also engaged in post-talk discussion via a dedicated Slack workspace. It is notable that one of these speakers was Andrew Reis (SMU’22), an undergraduate Hamilton scholar here at SMU.



Researchers Become Leaders in the ATLAS Higgs Particle Program

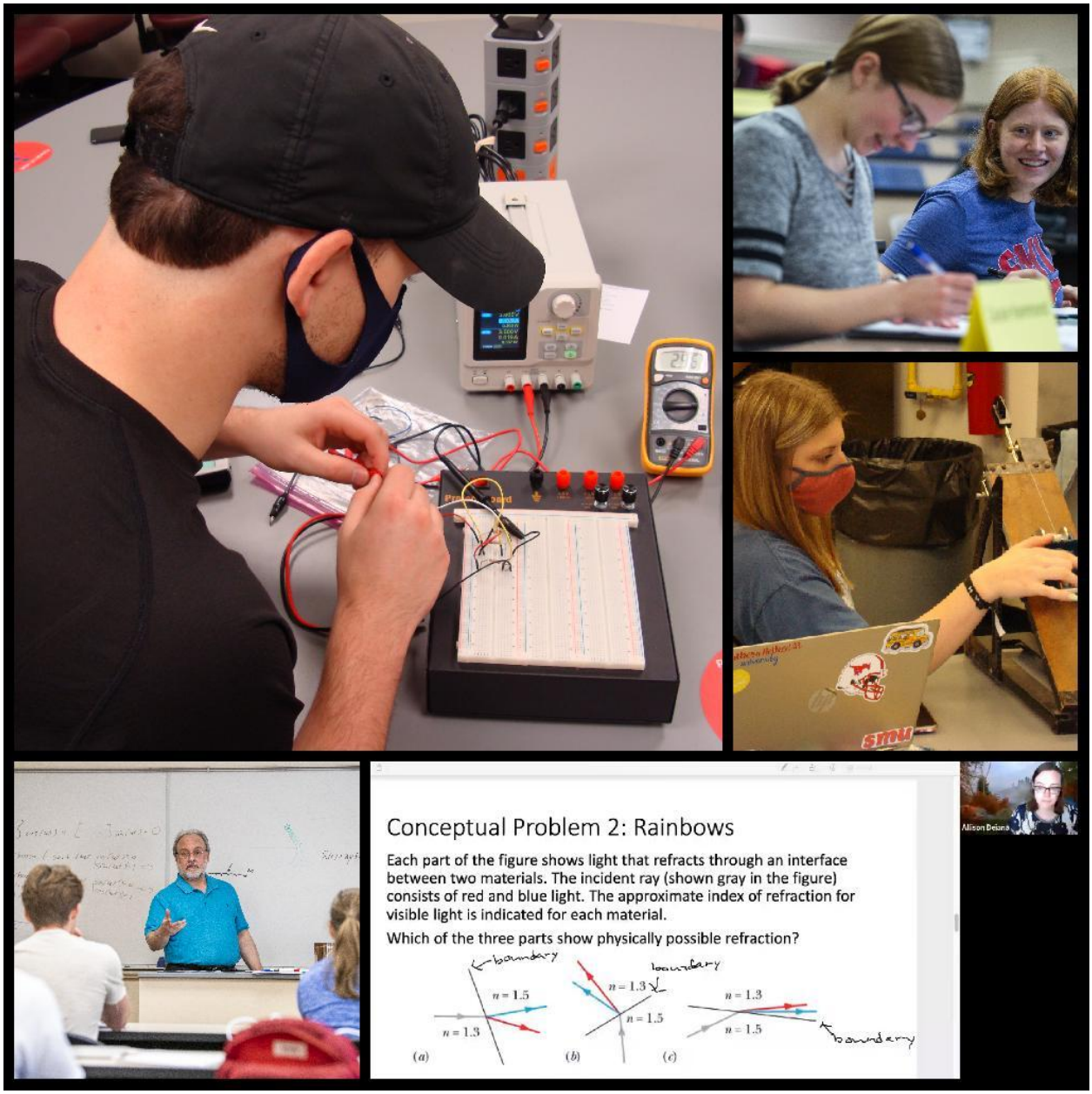
In the last year, two SMU researchers have become significant leaders in the ATLAS Experiment's Higgs particle research program. Dr. Katharine Leney (Research Assistant Professor) and Dr. Alessandra Betti (post-doctoral researcher) were each selected to serve in supervisory positions with emphasis on an extremely rare Higgs particle production mechanics: two-Higgs production.

Dr. Katharine Leney

Dr. Alessandra Betti

Dr. Leney was selected as the Co-Convener of the ATLAS Higgs and Dibsoson Searches (HDBS) analysis working group (AWG). An AWG is a major research organizational unit on the ATLAS Experiment, host to hundreds of physicists working on a focused set of topics. In this position, she is directly supervised by the ATLAS Physics Coordinators, the highest-ranking science positions on the experiment. Dr. Betti serves as Co-Convener of the HDBS analysis subgroup on Di-Higgs Production, a subset of the overall HDBS activities concentrated on looking for and studying the ultra-rare production of two Higgs particles in a single proton-proton collision. This area of physics is a key concentration, in general, for the SMU ATLAS Experiment research program and is a priority of the field now and for the coming decades.

Spotlight on Teaching



The Forge of Teaching

By Stephen Sekula, Associate Professor of Physics
(Originally published in "Inside Dedman College Newsletter", Vol. 6, Fall/Winter 2020)

This pandemic has exacted a high cost on human societies. Universities and colleges have obviously not been immune from the effects. In particular, the purpose of the university - the creation of new ideas and knowledge - is assailed by the realities of this pandemic. The mission of an institution like SMU is driven both by scholarship and teaching. While my own primary interests are in research, in this article I wish to focus on how COVID-19 has forced us to reshape a curriculum from physical to virtual space.

I would like to share the trials and lessons so far from the pandemic, using experiences in the Physics Department as examples, in the hopes that we can continue to learn from this experience for the betterment of all.

Learning in the Spring, Summer, and Fall

If the spring term was the crucible in which old conceptions of university teaching were melted, the summer term was the molding of new approaches and the fall term has been the forging. In the spring, all of higher education was forced to operate in unfamiliar territory on extremely short notice. Faculty and students were generally tolerant of stumbles during this period; we all recognized everything was coming undone. In the summer, however, students expected more. In physics, we actively saw students drop summer-term classes because they were dissatisfied with the quality of remote course content inherited from the spring. It was clear that we had to up our game for the fall. Between the summer terms and the start of fall term was a narrow window in which to shape a better learning experience. Our department employed digital teaching "hack-a-thons," where people shared ideas, rapidly identified problems, and solved them in real time. Faculty re-shot lecture video material and reimagined course structure and pacing. A narrow two-week period set the mold for the autumn.

Virtual Classrooms

It is generally agreed that in university education the face-to-face interaction of students with their peers and the instructor provides the highest efficiency transfer of information and training in the creative arts and critical thinking. A virtual classroom - one where neither the instructor, nor the students, occupy a common space - is therefore a challenge to this way of operating. However, the fully virtual classroom offers some key advantages: risk of transmitting the SARS-CoV-2 virus is essentially zero; there is no meaningful time required to "get to class," because it's a web link away, making time management between classes almost effortless. The disadvantages of this approach are many, of course: conversation is difficult, as most video conferencing systems fail to transmit the body language and microexpressions available in a physical space; it's easy to step all over each other when

trying to talk, because microphones cannot yet replace speaking in a shared space; group work is difficult, even with digital "break-out rooms," because people are still not really "together" in a way that promotes easy collaboration; instructors have to be very aware of time and remember that just because it's easy to transition between classes doesn't mean you can only leave one minute for students to do so.

That said, since nearly all but our large introductory-level classes were virtual, our department has a lot of experience with this type of classroom. The consensus seems to be that, even with their limitations, virtual classrooms "just work": students show up, they participate (if awkwardly through digital tools), the whole class period is easily recorded for students unable to attend that day, and a digital content management system (Canvas, in our case) permits a flow of information between student and instructor.

Virtual classrooms are probably the lowest-stress option for everyone involved, even if the teaching or learning experience can sometimes feel like the equivalent of drinking flat soda.

"While teaching during a pandemic will never be 'normal,' the goal is nonetheless to accomplish the mission of the University: to shape potential world-changers into the leaders, thinkers, and problem-solvers that the future so desperately needs."

Flexible Classrooms

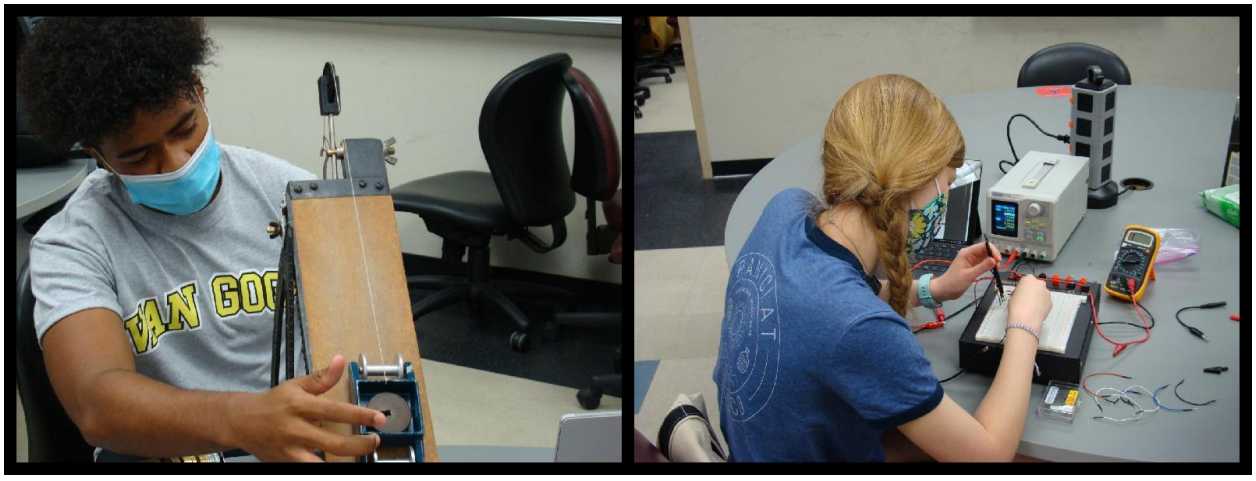
Flexible classrooms, where the instructor is present in a teaching space at SMU also co-occupied by in-person students, complemented by the remaining students being connected virtually (in real time), sound like they should be better for learning and teaching. Experience, however, has taught us this is not true, for one simple reason: the instructor is now also the director and producer of their own classroom live television show. With that reality comes all the engineering bumps and bruises of managing a real-time interactive broadcast. Unlike in a professional broadcasting studio, there is no one "running the board" for the instructor - that's left to the instructor, in addition to having to set up at the beginning of class, then actually teach, and then tear down everything to get out of the way for the next instructor. During class, one small mistake can cost you half your audience.

Students who can be present in the room have generally reported an acceptable experience, though group work is still frustrating because you cannot get closer to your peers than 6 feet. Masks, necessary to prevent viral spread, can inhibit speaking and frustrate listening comprehension.

Students connected virtually to these classrooms report high degrees of frustration, to the point where the desire to simply stop attending class is overwhelming (they can always watch the classroom recording later and catch up, of course). Faculty report being immensely frustrated with this approach, simply because of the sheer amount of new responsibility on their plate (cameras, microphones, batteries in devices, streaming services, etc.).

Laboratory or Workshop Classes

A class where students need to be highly hands-on with equipment or practices make for a particularly challenging environment. In our department, the introductory physics labs serve about 300 students each semester. These students are usually split over 12 sections each serving 27 students. Each lab section would normally be three hours long, with the first hour devoted to team-based cooperative problem solving and the remaining two hours devoted to laboratory practice. The rooms, however, can only hold nine students when socially distanced, and there are only two such laboratory spaces in our department. We solved this problem the way all departments at SMU had to this semester: creatively. We broke the three hours into three one-hour cohorts. For the first hour, one cohort is in the lab taking their data; the other two cohorts are engaged in problem solving activities, done entirely virtually. For the second hour, the cohort that took data in hour one is now doing the problem-solving activity. That means the instructors who handle the problem-solving activity are spending twice as much time this semester running those activities as in the past; meanwhile, the students are getting 50 percent less time in the laboratory space to take their data. Some students are participating entirely virtually, but we nonetheless accommodated that situation with data sets collected for them from the experiments each week. The only practice those students are missing is the one hour of data collection; everything else for them is the same.



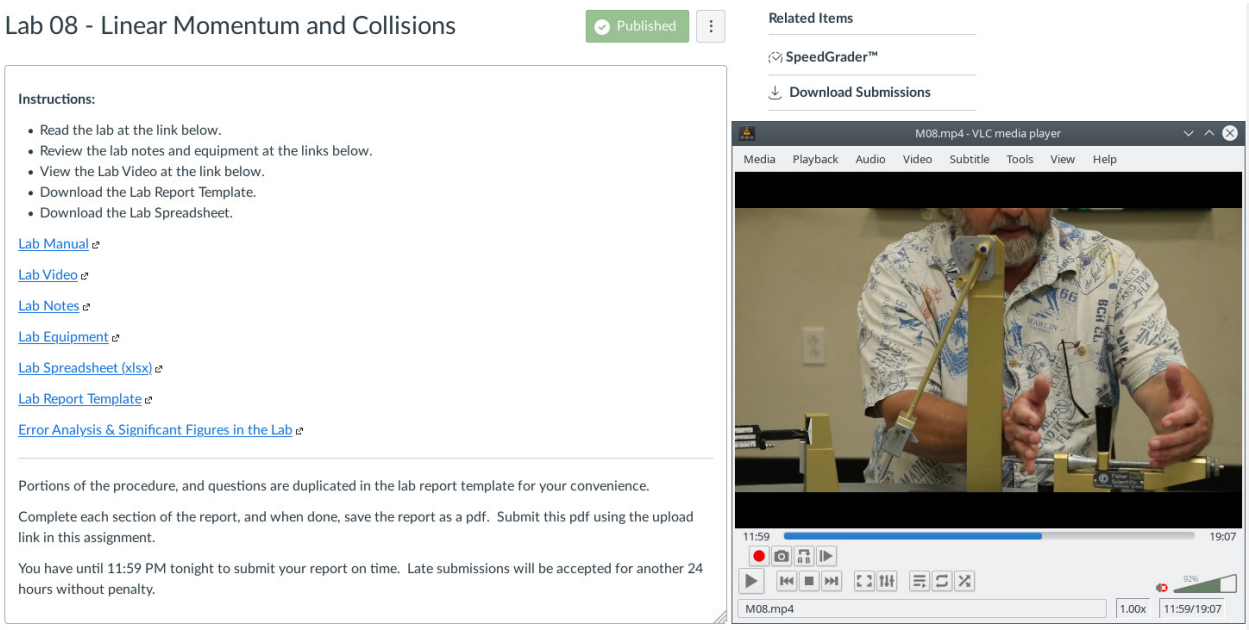
Shaping the Spring

Like all departments at SMU, the Physics Department keeps the eye on the future and learns from the present. The goal is to improve each time, making the experience better for instructors and students. While teaching during a pandemic will never be “normal,” the goal is nonetheless to accomplish the

mission of the University: to shape potential world-changers into the leaders, thinkers, and problem-solvers that the future so desperately needs. If the university is the anvil on which new ideas are forged, I am encouraged by the hammer that has been the commitment and creativity faculty have brought to solving each new problem; our desire to improve is sustained by the fire that is the enthusiasm students have for learning and discovering - even in these strange and difficult times.

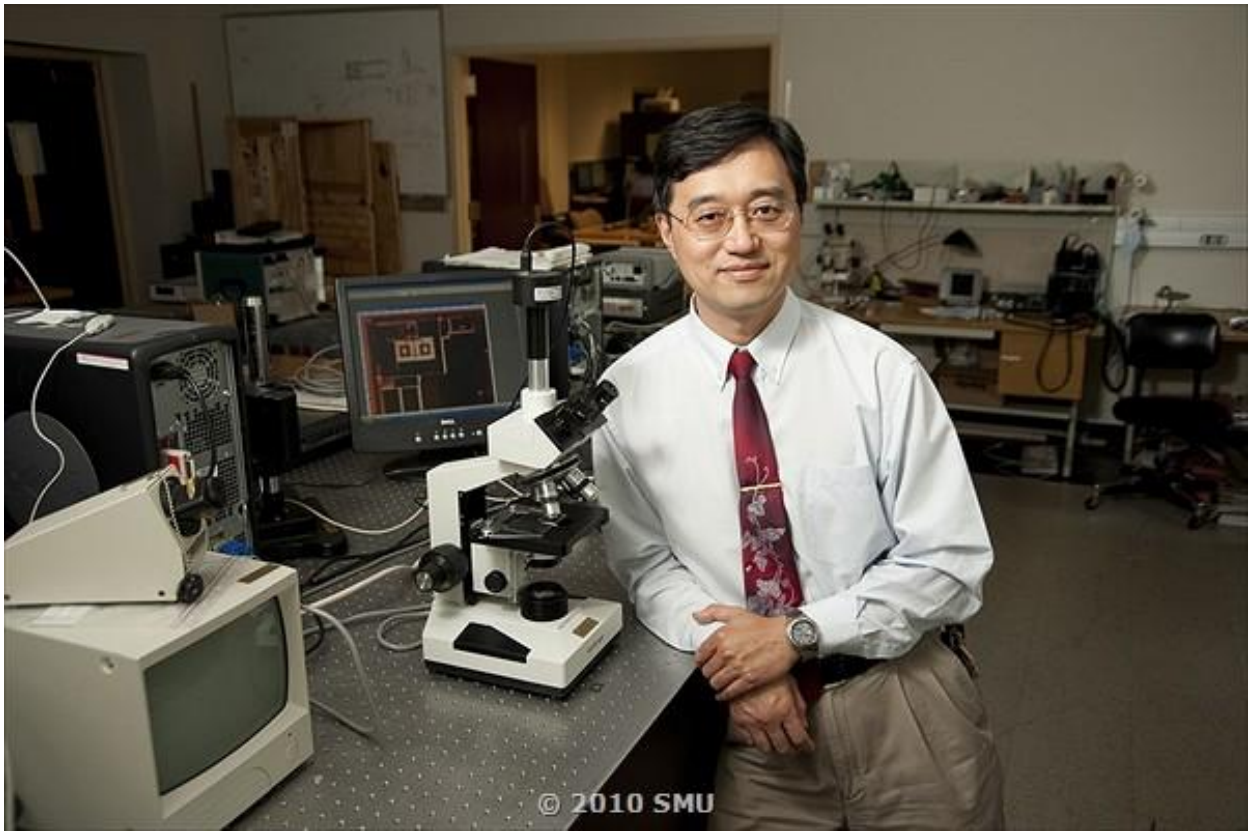
Prof. Stephen Sekula is an Associate Professor of Physics at SMU, Department Chair, and an expert in computational and experimental particle physics. In addition to his research, he teaches courses at all levels in the department. He is also the co-author of “Reality in the Shadows (or) What the Heck’s the Higgs?” (YBK Publishers), aimed at a general audience. He joined the faculty at SMU in 2009.

A Herculean Task: Moving Laboratory Classes Online

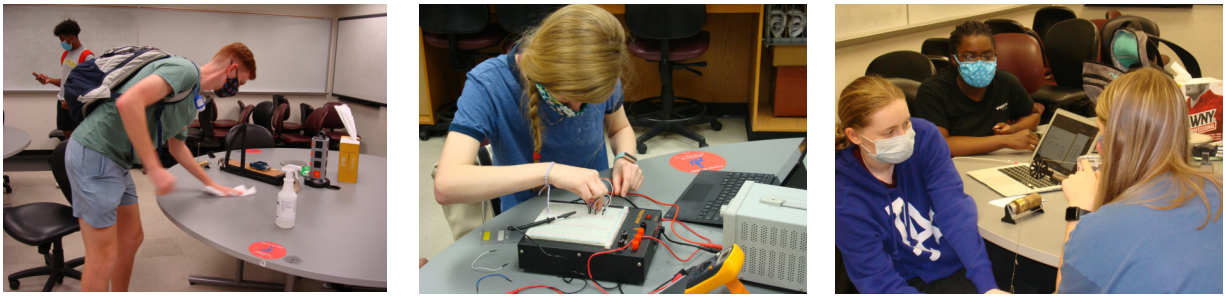


The SMU campus was formally closed to in-person instruction for the Spring 2020 term as of spring break of that year. This short period of time was all that faculty had to revamp their courses for online-only instruction. This included our introductory laboratory courses, which are normally extraordinarily hands-on. Prof. Jingbo Ye and Lab Manager Rick Guarino were already in the midst of an effort to overhaul instruction in those labs at the time the pandemic hit the university. They turned their attention to shooting lab lecture videos, gathering data into digital formats for students to

analyze, and moving other components entirely online. During the summer 2020 terms, they reshot every single lab lecture video to improve quality, in response to student feedback. It was an incredible effort that benefited the department and, most importantly, our students.



Prof. Jingbo Ye, shown here in the SMU Opto-Electronics Laboratory, is currently coordinating the effort to modernize the introductory physics laboratory classes.



Scenes from the in-person component of the introductory physics laboratory classes.

Spotlight on Faculty

Promotions and Awards

The department was proud to mark the promotion of Prof. Jodi Cooley and Prof. Pavel Nadolsky both to the rank of Full Professor. Promotion to Full Professor indicates that the candidate has achieved a high level of significant work in research, teaching, service to the university and the community of practice, and other substantive contributions.

Professor Jodi Cooley

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. Dr. Cooley is a Principal Investigator on the SuperCDMS dark matter experiment. She has won numerous awards for her research, teaching and mentoring. In 2012, she was a recipient of a prestigious National Science Foundation Early Career Award, one of only a handful of recipients nationwide in physics for that year. In 2018 she was elected a fellow of the American Association for the Advancement of Science (AAAS) for contributions to the search for dark matter scattering with nuclei, particularly using cryogenic technologies. In 2019 she was the recipient of the Klopsteg Memorial Lecture Award from the American Association of Physics Teachers (AAPT).

Dr. Cooley's current research interest is to improve our understanding of the universe by deciphering the nature of dark matter. She and her collaborators are building a new upgraded dark matter detector with sophisticated cryogenic detectors that are sensitive to the lowest mass dark matter particles. Construction is ongoing in SNOLAB, an international underground research laboratory located in Sudbury, Canada. The first competitive dark matter results from this experiment are expected from short runs that will take place in detector test facilities before the full payload is installed. First science data from the full payload is expected in 2023. In 2020, Dr. Cooley attracted to SMU the SuperCDMS SNOLAB Operations Grant, which goes toward funding all experiment operations across multiple collaboration institutions for August 2020 - August 2021.

Prof. Jodi Cooley was honored in Fall 2020 by the Texas Section of the American Physical Society (TSAPS) with their Distinguished Service Award. The award is given *" … to recognize individuals who have made outstanding contributions over several years to the Texas section of the APS. Recipients of this award will become members of a committee to aid and advise the Texas section's executive committee particularly in retaining a historical perspective on the section's activities. Service on the committee will include a four-year active term and lifetime honorary membership."* The presentation of the award was made by Prof. Sally Hicks (University of Dallas), past Chair of the TSAPS. In the citation she read, she noted Prof. Cooley's service in the leadership of the TSAPS and her reinvigoration of the nomination process for the Robert S. Hyer Award.

Professor Pavel Nadolsky

Dr. Pavel Nadolsky received his doctorate from Michigan State University in 2001 and originally joined SMU as a postdoctoral research fellow from 2001 to 2004. He then went on to conduct further postdoctoral research with the High Energy Physics Theory Group at Argonne National Laboratory in Illinois from 2004 to 2007. He returned to SMU and joined the faculty in our department in 2008. In 2011, Dr. Nadolsky was a recipient of a prestigious Department of Energy Office of Science Early Career Award, one of only 5 particle theorists nationwide to be awarded such a distinction that year. He is currently the Co-spokesperson of the Coordinated Theoretical-Experimental project on Quantum chromodynamics (CTEQ) Collaboration. He has served on the SMU Faculty Senate and as the Director of Graduate Studies in Physics.

Dr. Nadolsky's primary work is on the theory of elementary particles at hadron colliders, which explores physical objects at the tiniest distances accessible to modern science. His recent efforts focus on observations of fundamental particle states at the Large Hadron Collider near Geneva, Switzerland. Dr. Nadolsky develops theoretical models predicting how particles are produced through strong and electroweak interactions. Without such models, observations of new effects at the LHC would be difficult, if not impossible. Dr. Nadolsky leads a research group at SMU that includes students and postdocs working together on studies of elementary particles. The group is most recognized for detailed CTEQ-TEA models of the internal structure of protons that are necessary for many theoretical computations. This is a a fascinating area of research that combines quantum theory, computer simulations, multivariate statistical analysis, and machine learning. The SMU group leads world efforts on this subject by performing large-scale analyses of collider data utilizing the full power of SMU's M2 high-performance computing cluster. Dr. Nadolsky is also a leading member of the global community that advances planning and development for the Electron-Ion Collider, a new machine to be constructed at Brookhaven National Laboratory in the U.S. during the coming decade.

Meet our Newest Faculty

The department was proud to welcome three new faculty in the last few years. Read on to learn more about their research and how it will transform both SMU and what we know about the universe.

Prof. Allison Deiana earned her undergraduate degree in physics at North Carolina State University before pursuing and earning a Ph.D. in physics at the University of Illinois Urbana-Champaign. After conducting post-doctoral work at the University of Michigan she joined the faculty at SMU in 2018 as an Assistant Professor.

Her research program is focused on the ATLAS Experiment at the Large Hadron Collider, where she pursues physics topics related to searches for new particles and the study of the Higgs particle. She has been a leader in the beyond-the-Standard Model Higgs physics community on the ATLAS

Experiment and now focuses on Higgs interactions. She and her group are in pursuit of a measurement of the Higgs “self-interaction” which she investigates through the study of two-Higgs (or “di-Higgs”) production as well as single-Higgs production involving top quarks. Her group is also focused on developing firmware needed for upgrades to the ATLAS Liquid Argon Calorimeter.

Prof. Joel Meyers grew up in Phillips, Wisconsin and obtained his B.S. in Physics and Mathematics from the University of Wisconsin-Madison. He then went on to earn a Ph.D. in Physics from the University of Texas at Austin, conducting his doctoral work with Nobel Laureate Prof. Steven Weinberg. After post-doctoral work at the Canadian Institute for Theoretical Astrophysics he joined the faculty at SMU in 2018 as an Assistant Professor.

His research focuses on theoretical cosmology. He studies the history, evolution, contents, and fate of the Universe at large. His interest in cosmology is two-fold: cosmology is the ultimate origin story of our existence, and the conditions of the early universe left observable imprints in the sky which allow a unique window into the fundamental laws that govern the world around us.

His most recent work has been on the cosmic microwave background, radiation left over from the hot, dense plasma that filled the Universe more than 13 billion years ago. He is a member of two collaborations which aim to survey the cosmic microwave background at unprecedented precision in the coming decade, Simons Observatory and CMB-S4. He serves at the Co-Chair of the Science Council on CMB-S4.

Prof. Krista Lynne Smith grew up nearby, in McKinney, Texas, and obtained her B.S. in Astronomy from the University of Texas at Austin. She then went on to earn a Masters and Ph.D. in Astronomy from the University of Maryland. She then earned a prestigious Einstein Postdoctoral Research Fellowship which she pursued at the Kavli Institute for Particle Astrophysics and Cosmology at Stanford University. She joined the faculty at SMU in 2020 as an Assistant Professor.

Her current research focuses on the dynamics of supermassive black holes, 100s of millions of times the mass of our own sun and from which no light can escape. These appear to inhabit the center of every galaxy in the universe (including our own Milky Way Galaxy) and whose behaviors have a strong impact on the evolution of galaxies. Since joining us at SMU, she has already hit the ground running, attracting external funding for her work and publishing at least two first-author papers in Fall 2020. Her work opens up new avenues of investigation in astrophysics and astronomy for SMU.

Spotlight on Students and Alumni

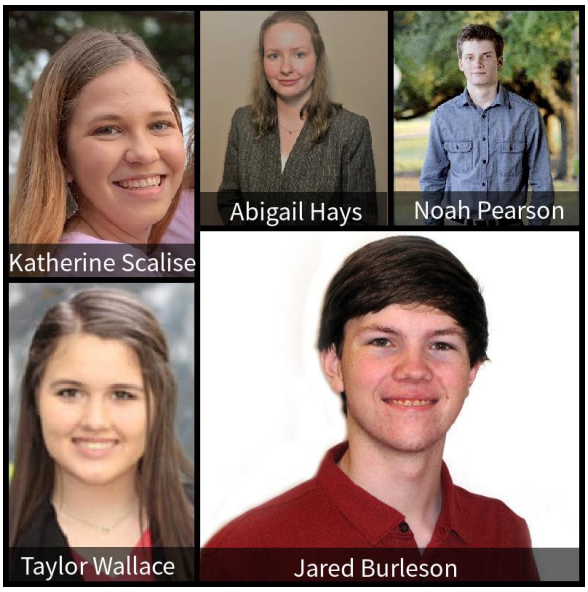
SMU Chapter of the Society of Physics Students "Outstanding" Nationally

The SMU chapter of the Society of Physics Students (SPS) has won an Outstanding Chapter Award from the SPS National Office. This is the first time the chapter has been recognized at the highest level of excellence as a top-tier student-led physical sciences organization, a designation given to fewer than 10 percent of all SPS chapters at colleges and universities in the United States and internationally (more than 800 chapters are in operation). Last year, our chapter was noted as "Distinguished" by the national organization.

The Society of Physics Students (SPS) is a professional association designed for students and membership is open to anyone interested in physics and related fields. SPS operates within the American Institute of Physics (AIP), an umbrella organization for professional physical science societies.

The SPS chapter at SMU is advised by Prof. Randy Scalise and is led by student officers. The 2020-2021 officers are:

- Jared Burleson (President)
- Taylor Wallace (Vice President)
- Katherine Scalise (Secretary)
- Noah Pearson (Treasurer)
- Abigail Hays (Outreach Coordinator)



SPS chapters are evaluated on their level of interaction with the campus community, the professional physics community, the public, and with SPS national programs. The Outstanding Chapter Award recognizes high levels of outreach as well as unique approaches to fulfilling the mission of SPS to "help students transform themselves into contributing members of the professional community."

Prof. Scalise and the student officers have created and sustained a vibrant chapter of the SPS at SMU. This is especially notable in this pandemic year, when gathering in person has been impossible, but where virtual events were done creatively and routinely.

SMU Physics Students Recognized with Honors and Awards

David (Tyler) Blake (Chalk)

Jared Burleson (Chalk)

Stephanie Gilchrist (Wiley)

Abigail Hays (Wiley)

Amy Hermann (Physics Scholarship)

Jason Keyzer (McDonald)

Noah Pearson (Hyer)

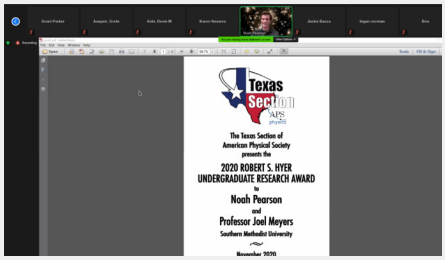
Undergraduate Awards

The Robert S. Hyer Scholarship in Physics at SMU

Awarded to a student who performs at the highest academic level. In memory of Robert S. Hyer, physicist and first President of Southern Methodist University.

Robert Stewart Hyer was regarded in the physics community for his work with x-rays and wireless communication. He is the first American ever known to have transmitted a signal wirelessly over a distance of about 1 mile. He did this within a year of Heinrich Hertz's discovery of electromagnetic waves. Such experiments set the stage for the modern wireless communication revolution. President Hyer was one of the founders of SMU and his hand in the formation of our university can be seen across the campus, even today, as he set the standards still cherished by students at SMU: the school colors (Yale Blue and Harvard Crimson), the composition of the brick used in the campus architecture, and the design of Dallas Hall. Hyer served as a member of the faculty of SMU until he passed away in 1929.

- Noah Pearson [2021]



Prof. Joel Meyers and Noah Pearson Awarded the 2020 TSAPS Robert S. Hyer Award

This award is presented by the Texas Section of the American Physical Society (TSAPS) to one undergraduate-mentor pair each year. The TSAPS notes that "the only criterion is excellence, including potential impact in the relevant scientific community."

Noah and Prof. Meyers were recognized for the work embodied in their recent paper, "Searching for Gravitational Waves with Strongly Lensed Repeating Fast Radio Bursts" (*see "A Song of Supermassive Black Holes" on pg. 6*).

The Fall 2020 joint meeting of the TSAPS, American Association of Physics Teachers, and Society of Physics Student was held virtually in October 2020.

The TSAPS Hyer award is distinct from our departmental Hyer award, though they share a common namesake.

The Katharine Sams Wiley Physics Scholarship

Award based on merit to students at the sophomore level or above who are majoring in physics, with attention to women focused on science and engineering. This scholarship was made possible by a generous endowment provided by Mrs. Katharine Sams Wiley.

- Abigail Hays [2021]
- Stephanie Gilchrist [2021]

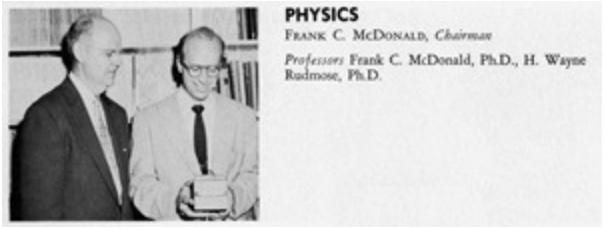
The Jeff Chalk Physics Award

Given in honor of former SMU physics professor Dr. Jeff Chalk to a student who embodies Dr. Chalk's passion for promoting the learning of physics.

Professor Jeff Chalk earned his PhD in Physics from University of Colorado in Boulder and served as a member of the SMU Physics Faculty for over 30 years. During that time, he had a tremendous influence on the teaching of physics and on the lives of students who took his classes. He was especially famous for dramatic demonstrations of core physics ideas. "He drinks liquid nitrogen!" exclaimed one student in a teaching evaluation. Jeff had a passion for physics that informed his teaching and inspired learning in his students.

- David (Tyler) Blake [2021]
- Jared Burleson [2021]

The Frank C. McDonald Memorial Award



The Frank C. McDonald memorial award is based on merit and given in memory of Dr. Frank C. McDonald, chair of the Physics Department from 1941-1962.

Prof. McDonald was remembered by his students for engaging them in the struggle to understand physics concepts and solve problems using those concepts. It wasn't about memorizing equations; it was about understanding what they meant in order to solve new problems or create new knowledge.

- Jason Keyzer [2021]

The Physics Undergraduate Scholarship

Awarded annually to recognize merit and financial needs on the path toward the successful completion of the undergraduate degrees in Physics.

- Amy Hermann [2021]

Susan
Bataju
(Tittle)

Sully
Billingsley
(Tittle)

Ryne
Dingler
(Tittle)

Macon
Magno
(Tittle, Outstanding TA)

Mohamed
Saadawy
(Tittle)

Reagan
Thornberry
(Tittle)

Rajeev
Vaisakh
(Tittle)

Jing
Xiaoxian
(Lightner Sams)

Graduate Awards

The Charles W. Tittle Starting Line Award

Created in 2020, this award provides early financial support to our newest graduate students in recognition of their potential for future excellence, with the intent to help them bridge between the undergraduate and the graduate experience. Dr. Tittle had an extraordinary career in nuclear physics that took him from research at what is now University of North Texas to SMU, where he first was on the faculty in the school of engineering and later served as Chair of the Physics Department, then on the Faculty Senate. It is said that he always ran, never walked, everywhere he went on campus. We want our graduate students to have a good start so they can get running toward their goals.

- Susan Bataju [2020]
- Sully Billingsley [2020]
- Ryne Dingler [2020]
- Macon Magno [2020]
- Mohamed Saadawy [2020]
- Reagan Thornberry [2020]
- Rajeev Vaisakh [2020]

Outstanding Graduate Teaching Assistant Award

The Outstanding Graduate Teaching Assistant Award is given annually to a graduate student whose dedication and skill in the academic instructional environment enhances the classroom experience for the students. Nominees should have served as a teaching assistant in the most recent summer, fall, and spring terms. Recipients of this award go above and beyond the call of duty in helping students to learn, improving the content of the course, or developing new ideas to improve outcomes for students.

- Macon Magno

Lighter Sams Outstanding Graduate Research Award

The Lightner Sams Outstanding Graduate Research Award is a new award, given annually to recognize high levels of achievement in the research environment. The only criterion for this award is excellence. Recipients of this award have contributed to the knowledge of humanity through their unique contributions that emerge as a natural part of the doctoral research process.

- Jing Xiaoxian

New Graduate Student and Department Community Space

The department, with support from Dedman College, renovated a space in the Fondren Science Building into a new graduate student office, research, collaboration, and social space. In addition to desk and storage areas for each student, the venue contains mobile whiteboards, work tables for collaborative activities, a more casual seating area, and a cafe space. The cafe has been dubbed “The Hyer Ed Cafe” and will serve not only graduate students, but also the department, as a hub for intellectual events with a social component. We are excited to re-open this space later this year.

Jared Burleson Named Schwarzman Scholar

(This news release is originally from SMU News and is reprinted here with additional photographs to accompany the original announcement.)

Jared Burleson was studying in Jiangsu, China, the summer after his first year at SMU, taking advantage of the study abroad benefits that come with being a President's Scholar, SMU'S highest academic merit award. While waiting in line for tea at a local shop, he overheard two men speaking English, then recognized one of them as Nobel Prize-winning physicist Michael Kosterlitz.

Jared introduced himself, and began chatting with the world-renowned scientist who was in China with another colleague to encourage international scientific collaboration.

"I had never heard of the physics community in China," Jared says. "I was inspired by my conversation with them to continue studying Chinese and someday work with the particle physics research community in China."

Three years later, Jared, a senior from North Richland Hills, Texas, has been named a Schwarzman Scholar, one of the world's most prestigious and selective international fellowships. He is one of 154 scholars from 39 countries and 99 universities chosen from 3,600 applicants to study for a year at

Tsinghua University in Beijing, China – an opportunity that sets him firmly on the path to achieving his dream.

Applicants for the Schwarzman Fellowship are selected based on their demonstrated leadership, academic excellence and desire to create global change. During this second trip to China, beginning in August 2021, Jared will earn a master's degree in global affairs with an emphasis in public policy at Schwarzman College, which will feature coursework, cultural immersion and mentoring in order to equip him with an understanding of China's changing role in the world.

Jared (center), Professor Xinsheng Sean Ling (Brown University, left), and Nobel Laureate Professor Michael Kosterlitz (Brown University, right) during their serendipitous meeting in Beijing in 2018. Photo courtesy of Jared Burleson.

For Jared, the fellowship offers a unique opportunity to merge his interest in China and particle physics public policy, an unlikely combination that makes sense to students like him who look at science as a global collaboration and understand the complex relationship between government and science. His interests include learning how particle physicists in China work with government officials to propose research projects and receive funding.

"The next frontier in particle physics will be in China," says Jared, who is minoring in Chinese. "An important qualification of collaborating with the particle physics community in China will be an understanding of not only the Chinese language but also the structure of government and public policy in China."

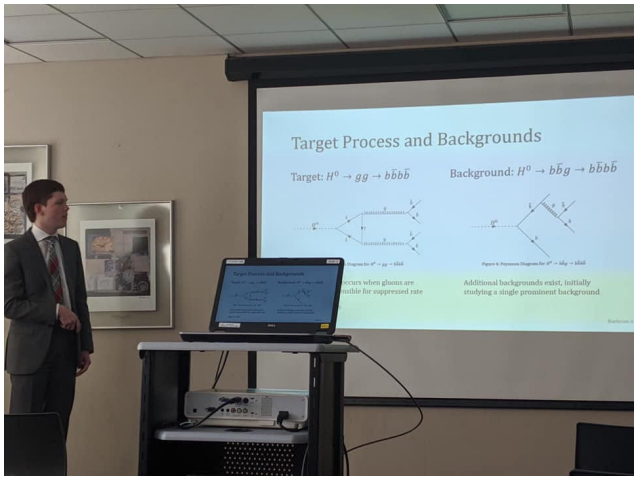
"The SMU physics faculty is really interested in mentoring students," Jared says. "When I was visiting SMU they asked me how they could support my interests instead of recruiting me to help them with their interests."

Jared Burleson

The timing couldn't be better for Jared. The Institute of High Energy Physics in Beijing has submitted a proposal to the Chinese government to begin construction on a particle collider, a machine that would be a major successor to the Large Hadron Collider located at CERN, near Geneva, Switzerland.

Science is a global enterprise, says Steve Sekula, SMU associate professor of physics and one of Jared's mentors. "But its effectiveness depends on cooperation between nation states," he says. "It's magnificent that someone Jared's age is coming into our field understanding that human relationships are essential going forward."

Jared says he selected SMU because of the opportunity to become part of its physics research community as an undergraduate.



By November of his first year at SMU, Jared was researching dark matter detection with physics professor Jodi Cooley and Ph.D. student Dan Jardin. Later he became lead undergraduate researcher for Sekula, who studies particle physics and is part of the SMU team that conducts research with ATLAS at CERN. The SMU ATLAS team contributed in 2012 to the discovery of the Higgs boson.

"The SMU physics faculty is really interested in mentoring students," Jared says. "When I was visiting SMU they asked me how they could support my interests instead of recruiting me to help them with their interests."

Jared was poised to spend the summer of 2020 researching at CERN as part of a National Science Foundation program when his plans were interrupted by COVID-19 travel restrictions. Instead, he joined a project that is proposing a new collider experiment in the United States, the Electric-Ion Collider. He was the only undergraduate student in his portion of the project.

But it's not all physics, all the time, for Jared. He sings with SMU's Meadows Chorale, served on the student governing council for Ware Commons and volunteers at the local food bank. He also is a University Honors student and president of SMU Chapter of the Society of Physics Students, which was just named one of the top 15 percent of chapters by the national organization.

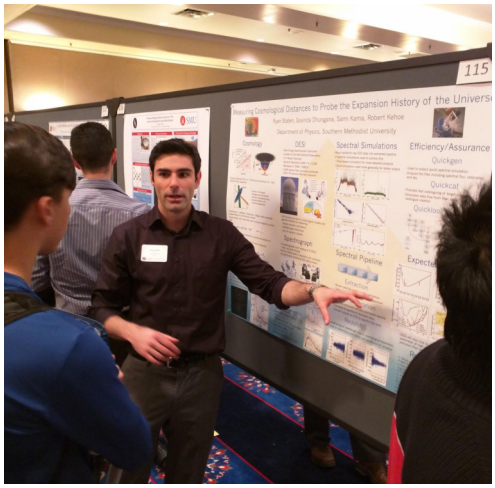
"Jared has great enthusiasm and curiosity," Sekula says. "That can carry you through a lot of things. Even if things get tough, and they always do, Jared has the ability to push through."

Degrees Awarded

Madalyn McKay, Ph.D. '20
Advisor: Prof. Ryszard Stroynowski

Dr. Madalyn McKay earned her Ph.D. in August 2020 for her measurements of the properties of the Higgs particle discovered in 2012. Her thesis, entitled "Measurement of Inclusive Fiducial and Differential Cross Sections in the H→ZZ*→4l Decay Channel in p-p Collisions at 13 TeV with the Full ATLAS Run 2 Dataset,"[4] documented how the production processes that lead to Higgs particles at the Large Hadron Collider can now be measured with unprecedented precision using a very "clean" method of reconstructing the Higgs particle using the ATLAS Experiment. Dr. McKay now works on market risk analytics at Citi. She earned her B.S. degree from Carnegie-Mellon University before joining the Ph.D. program in Physics at SMU.

Ryan Staten, Ph.D. '20
Advisor: Prof. Bob Kehoe



Dr. Ryan Staten earned his Ph.D. in August 2020 for his measurements of the expansion properties of the universe. His thesis, entitled "Constraining H_0 with ROTSE Low z Supernovae and Baryon Acoustic Oscillations with DESI High z Galaxies and Quasars,"[5] documented how exploding stars and fluctuations in the density of the normal matter of the universe can be used to assess the expansion history of the cosmos. Dr. Staten is now an Adjunct Assistant Research Professor at SMU and continues his work on experimental astrophysics and cosmology. He earned his B.S. degree from Southwestern University before joining the Ph.D. program in Physics at SMU.

[4]McKay, M. "Measurement of Inclusive Fiducial and Differential Cross Sections in the H→ZZ*→4l Decay Channel in p-p Collisions at 13 TeV with the Full ATLAS Run 2 Dataset". 2020. SMU Scholar. https://scholar.smu.edu/hum_sci_physics_etds/10/

[5]Staten, R. "Constraining H_0 with ROTSE Low z Supernovae and Baryon Acoustic Oscillations with DESI High z Galaxies and Quasars". 2020. SMU Scholar. https://scholar.smu.edu/hum_sci_physics_etds/11/

Peilong Wang, Ph.D. '20
Advisor: Prof. Stephen Sekula

Dr. Peilong Wang earned his Ph.D. in December 2020 for his measurements of a key decay process of the Higgs particle. His thesis, entitled "Observation and Measurement of the Higgs Boson Produced in Association with a Vector Boson and Decaying to a Pair of Bottom Quarks with the ATLAS Detector at LHC,"[6] documented how the Higgs particle can be identified in its most prolific - but also one of its most challenging - decay modes. The thesis documents the observation and measurement of this process, first definitively observed by the ATLAS Experiment in 2018. After completing his Ph.D. he participated in The Data Incubator program to provide additional training and experience in machine learning and data science. He is now pursuing post-doctoral positions in physics. He earned his B.S. degree from the University of Science and Technology of China before joining the Ph.D. program in Physics at SMU.

Meet Some of our Distinguished Alumni

Dr. Lee Pondom
(University of Wisconsin-Madison)

Lee Pondrom (BS'53, center) is noted as an SMU Physics Distinguished Alumnus for his pioneering role in experimental studies of the hyperon magnetic moments and his leadership in the field of High-Energy Physics.

Dr. Roy Holt
(Argonne National Laboratory)

Roy Holt (BS'69) is noted as an SMU Physics Distinguished Alumnus for his pioneering role in experimental studies of the structure of the nucleon, especially though his study of the deuteron and photonuclear reactions.

[6]Wang, P. "Observation and Measurement of the Higgs Boson Produced in Association with a Vector Boson and Decaying to a Pair of Bottom Quarks with the ATLAS Detector at LHC". 2020. SMU Scholar. https://scholar.smu.edu/hum_sci_physics_etds/12/

THANK YOU

Thank you, our community, for keeping in touch with us, supporting us, and enhancing us as a physics department. We are sustained by letters and emails keeping us informed of your careers, life changes, and interests; by your generous donations to the department through general or targeted contributions; by your participation in department events; and by the memories and feelings you share with others regarding your experiences with our department.

A Guide to Gift Giving

We are grateful for the support of our donors, especially for contributions to the department that provide discretionary funding that can be spent on student awards and scholarships, student travel and research, teaching enhancement, and community-building activities. More than ever, we rely on these donations to enhance teaching and research excellence.

Each fund below has an associated QR code, which you can scan with a mobile device to go directly to the secure donation portal. Additional information about giving is available at the end of this section.

Priority Funds

The Physics Undergraduate Scholarship Fund

Donations to this fund provide support for an annual scholarship (currently at the level of a few thousand dollars) for undergraduate students who exhibit both merit and need. The goal of this award is to provide financial assistance to students to help them continue in their passion for the completion of the Physics degree. Nominations are made annually by the faculty to the Department Undergraduate Committee, and the committee selects the finalist(s). This fund is not endowed and relies on donations to the department to sustain this award.

The Lightner Sams Physics Fund

Originally created based on a generous donation from the Lightner Sams Foundation, this fund is used to provide research merit-based graduate awards and, when possible, to provide additional travel support for doctoral students pursuing their Ph.D. in Physics at SMU. This fund has also been used to bring expertise to SMU in support of graduate education, such as external leaders in the field whose presence at SMU can enhance graduate research and

education. This fund is not endowed and relies on donations to the department to sustain it.

The Jeff Chalk Physics Scholarship Award Fund

This fund supports the annual Jeff Chalk Physics Award(s). These are given annually in honor of beloved former SMU physics professor Dr. Jeff Chalk to a current undergraduate student who embodies Dr. Chalk's passion for promoting the learning of physics. This fund is not endowed and relies on donations to the department to sustain it.

Additional Important Department Funds

The Wiley Physics Scholarship Endowment Fund

Created based on a generous endowment from Mrs. Katharine Sams Wiley, this fund provides support for annual scholarships based on merit to students at the sophomore level or above who are majoring in physics, with attention to women focused on science and engineering. Donations to this fund are encouraged especially toward the principal to help increase the long-term impact of this award.

The Tittle Physics Fund

Created based on a generous endowment from Mr. Robert Mayer Jr., this fund was established as a tribute to the memory of Dr. Charles W. Tittle. This fund provides support for the graduate program, including the department speaker series (speaker travel support) to enhance graduate exposure to the leading ideas of the field as well as the new Charles W. Tittle Graduate Starting Line Award for new students, to help them make successful the difficult transition from undergraduate to doctoral studies. Donations to this fund are encouraged especially toward the principal to help increase the long-term impact of this fund.

The Physics Department Gifts Fund

This fund supports a wide and flexible range of discretionary needs beyond the scope of the department's general operating funds or external grant support. Recent impacts include teaching technology grants for faculty, undergraduate and graduate merit-based awards (such as the Frank C. McDonald Memorial Award or the Outstanding Graduate Teaching Assistant Award), conference and/or research travel support for students (undergraduate and graduate), and research equipment that cannot be funded by external grants. This fund is entirely sustained by donations.

How to Support Physics at SMU

Should you prefer to make your donation electronically by credit card on a secure server, please visit **https://www.physics.smu.edu/web/giving**. Click on the fund in which you are interested and then follow the instructions to conclude your secure transaction. You can also scan the QR code associated with each fund using your mobile device and will be brought to the secure donation portal.

If you wish to first engage with a Dedman College of Humanities and Sciences Development Officer to discuss your gift or other options including estates, trusts, gifts in kind, or planned giving, please contact Clayton Ellis, Director of Development for Dedman College, by phone at (214) 768-9202 or by email at crellis@smu.edu.

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Twitter: twitter.com/SMUPhysics

Friday Physics Newsletter:

https://blog.smu/edu/smuphysics

Since August 2020, we have published a weekly newsletter detailing activities in the department. Expect one issue each week during the fall and spring terms.

Physics Community Mailing List

Request to be added today to get occasional notices about our newsletter and special events. Mails typically occur once each week.

PhysicsCommunity@list.smu.edu

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Stephen Sekula

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