

Meet a few of our 2018 Summer Research Fellows



Corey Halverson, Junior

Advisor

Assistant Professor Miguel Madurga (left)

Research

Searching for fingerprints of a rare type of decay never seen in the synthesis of nuclei in neutron stars

They code. They grow thin films. They search for fingerprints of decay and model fractures in materials. It's all in a day's work for the UT Physics Summer Research Fellows, 14 undergraduates who spent 10 weeks working with physics faculty to learn more about their research and how it's done. Here are snapshots of a few of our 2018 fellows.

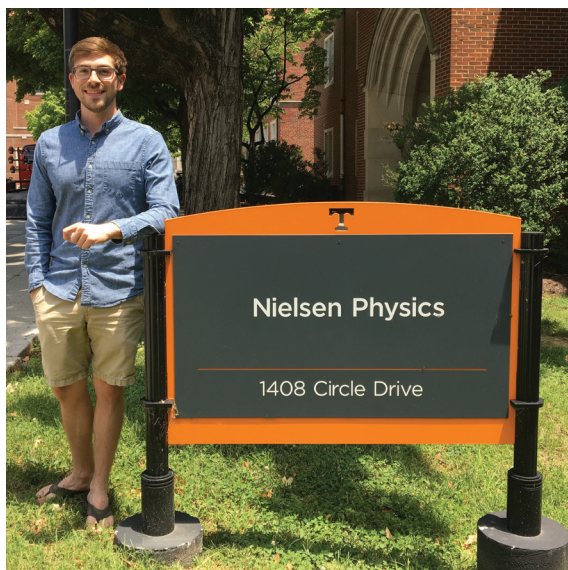
Charles Ladd, Junior

Advisor

Assistant Professor Max Lavrentovich

Research

Using fuse networks to make different ways, shapes, and lattices to model fractures in materials



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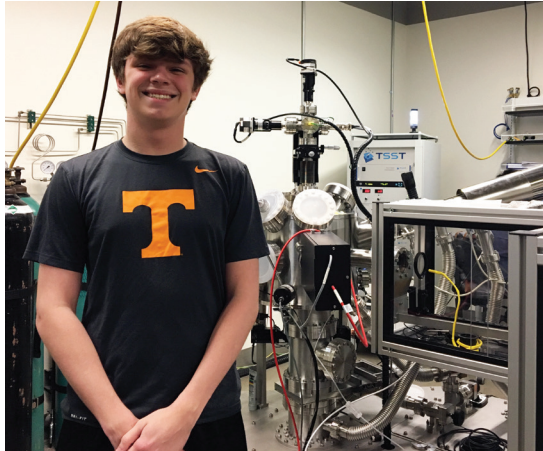
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Originally a project of the Science Alliance, a UT-Oak Ridge National Laboratory collaboration, the physics department took over sponsorship of the summer fellows program a decade ago. Faculty members offer projects and students apply to work in areas that interest them. Fellows earn stipends supported by department endowments or faculty grants. At the end of the summer they present their work to the other fellows and physics faculty, and have valuable experience to build on.



Kyle Noordhoek, Sophomore

Advisor

Assistant Professor Jian Liu

Research

Using pulsed laser deposition to grow yttrium barium copper oxide (YBCO) superconducting thin films



Mariah McCreary, Junior

Advisor

Associate Professor Christine Nattrass

Research

Coding simulations of heavy ion collisions in a new analysis program in hopes to gain more insight into the Quark Gluon Plasma



Ben Smith, Senior

Advisor

Professor Soren Sorensen

Research

Coding an event generator to analyze particle collisions as compared to experimental data



Justin Scott, Senior

Advisor

Joint Faculty Professor Raph Hix

Research

Created software for the analysis of experimental neutrino signatures from core-collapse supernova simulations



Hanno Weitering

Quantum Cluster

At the beginning of the new academic year, I would like to extend a special welcome to our new students, which include about 40 freshmen physics majors and 22 graduate students. This year's cohort includes quite a few international students from India, Nepal, China, and Brazil, as well as domestic students, including several students that came through our own undergraduate program. Interestingly, quite a few students indicated an interest in quantum information and quantum computing, a hot and rapidly growing research area with relatively little local UT expertise (more about that later).

Last summer I wrote about the significant increase in our undergraduate enrollment. According to the official numbers, there are now close to 170 majors in our program, up from roughly 100 physics majors 6 years ago. This increase follows the overall trend in UT's undergraduate enrollment, but should also be attributed to our open house events and high school outreach efforts. While this is very good news, it does present the department with some challenges. In the past, student waitlists were something that only concerned students enrolled in our large service courses, where the number of lab sections is limited by the number of graduate teaching assistants and seating capacity of our undergraduate laboratories, which is subject to fire code regulations. This has never been a problem for our own physics majors. Our classrooms and labs have always been big enough to accommodate our majors. Not anymore. Our upper level core courses are filled to maximum capacity each fall, while several other courses now have waitlists. In particular, the electronics laboratory has now become a bottleneck for timely graduation, and to meet the demand we now offer it every semester. The same goes for the modern physics course (PHYS 250) and the modern physics laboratory (PHYS 461), which are also offered every semester. In addition, we have doubled our course offerings for the 200- and 400-level astronomy courses. Fortunately, due to some modest growth in faculty size, we have been able to accommodate the increased teaching load. Further increases in course enrollment require access to bigger classrooms and/or increased faculty size. Nonetheless, it is a good problem to have as we all

like to see a vibrant program that produces more college graduates with physics degrees.

There were no new faculty hires last year but we will be searching for a junior faculty in experimental condensed matter physics this fall. In addition, we anticipate several more faculty hires in connection with UT's cluster hire initiative. These cluster hires will build on existing and emerging expertise at UT in order to reach a critical mass in key research areas that would enable UT researchers to tackle some of society's grand challenges. Following an open university-wide competition, a proposal on "Quantum materials for future technologies" led by Physics Professor Cristian Batista was chosen as one of two finalists. The clusters involve two senior and four junior faculty hires shared among the departments of physics, materials science and engineering, electrical engineering and computer science, and math. The main goal of the cluster will be to bridge the gaps between critical areas for the future development of quantum technologies, including quantum materials engineering, condensed matter physics, computer science, and quantum information. The effort will synergize with the high-performance computing and large-scale experimental facilities of ORNL. Clearly, the ever increasing need of quantum materials for quantum-based technologies and for quantum information and computation is demanding interdisciplinary approaches that transcends the barriers of departments and colleges. This problem connects lines of research that are central to both UT and ORNL.

Such a project does present its own challenges. Interdisciplinary research demands synergy among researchers with various backgrounds and expertise, meaning that the overall outcome in terms of scientific creativity and productivity should be greater than the sum of the individual contributions. Many centers fail this critical test. However, if done right, this cluster should transform the way we teach our students, especially our graduate students, and conduct our research. Once again, Physics may be able to live up to its reputation as UT's trendsetter in cutting-edge research and educational innovation.

Distinguished Alumnus Profile

Making the Most of Opportunity

Won Namkung is early. Despite the afternoon's gloomy weather, he has hustled up the Hill from his hotel with a spryness no doubt reminiscent of his grad school days some four decades earlier. He is the honored guest at the department's Honors Day celebration, where he will accept the 2018 Distinguished Alumnus Award, and he has come early to talk about a scientific journey that began with a simple wish to build a radio and grew into a career building multimillion-dollar accelerators.

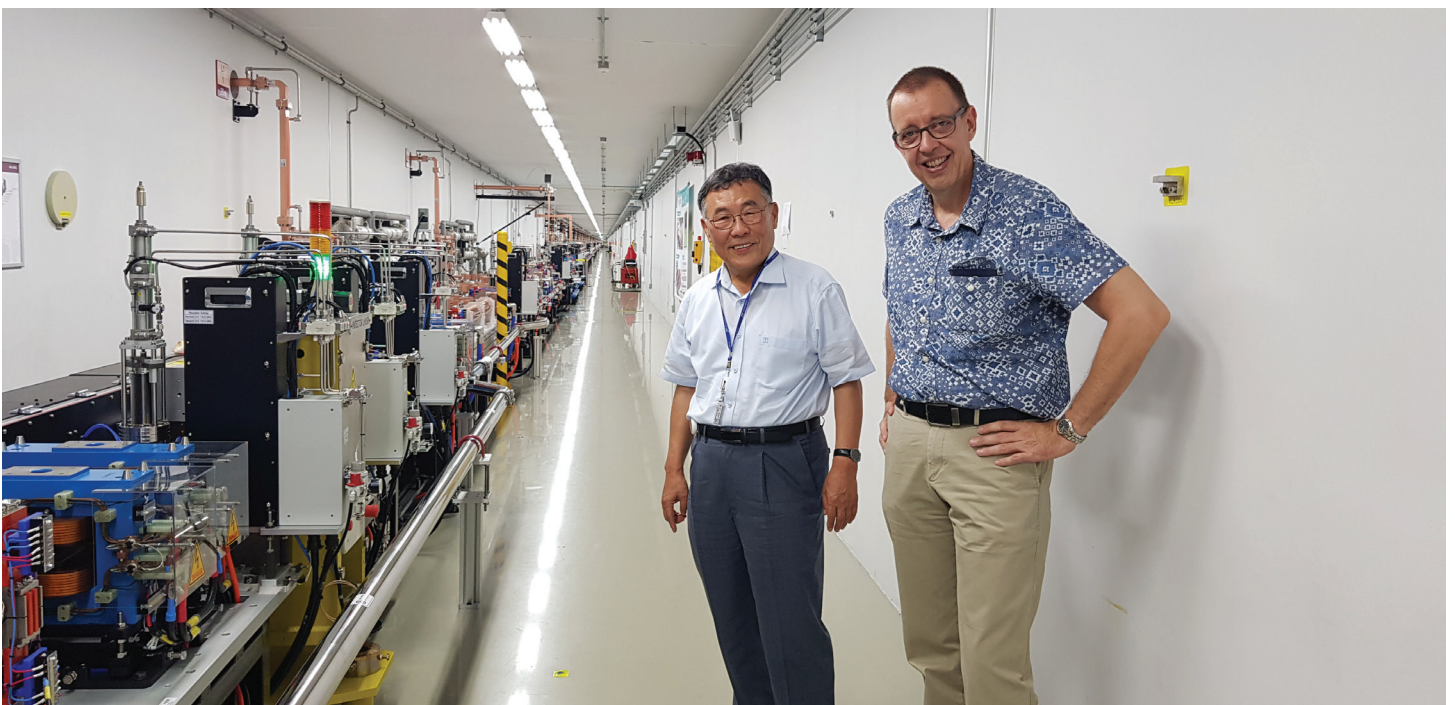
Seizing the Moment

Namkung was a boy in post-war Korea and remembers vividly the way technology dominated the news—the hydrogen bomb and nuclear submarines were curiosities to him as child. He wanted to build his own portable radio and was fascinated by television. Not the programming—just the equipment.

“At the time there's no television broadcasting in Korea,” he said. “What I can see is a 14-inch black and white television set on the store shelf.”

He followed the news of space exploration through high school and earned a bachelor's degree in physics at Seoul National University in 1965. After serving in the Korean Air Force he decided to pursue a doctoral degree. Logistics and family brought him to the University of Tennessee. Namkung was interested in fusion energy research and UT's neighbor Oak Ridge National Laboratory was doing that kind of work. He would also see a friendly face when he came to Knoxville.

Won Namkung and Professor Hanno Weitering at the Pohang Accelerator Laboratory X-ray Free Electron Laser Linac Tunnel in Korea



“My sister (Agnes) got admission here one year before me,” he said.

Namkung worked in the ORNL Fusion Energy Division as a graduate student and research associate. He earned a PhD in 1977 and soon joined the University of Maryland, and later the Naval Surface Warfare Center, learning about accelerators. Yet there were opportunities back in Korea, and Namkung, whose temperament is underlined by a fearless sense of optimism, was intrigued.

In the mid-1980s, the steel company POSCO established a university in Pohang to provide what Namkung called “excellent manpower” for a country that was rapidly modernizing. They called it POSTECH as a nod to Caltech, which espoused the sort of quality and prestige they had in mind for their new university.

“The steel company needed a new university, then the new university needed a president,” Namkung said. “The president is my good friend at Maryland. That is somehow fate.”

That friend, Hogil Kim, was keen to build an accelerator at POSTECH and he had just the candidate in mind to make it happen: Won Namkung.

“That kind of thing happens once in a million times,” Namkung said. “I wanted to do big science. I should not miss that moment.”

A Republic of Accelerators

In 1988 the university began construction of the \$180M Pohang Light Source (PLS), a third-generation synchrotron radiation source as part of PAL: Pohang Accelerator Laboratory. Namkung became the linear accelerator division head and deputy director, as well as a physics professor at POSTECH. The PLS was the first green field construction of a large-scale scientific facility in Korea. The project was completed in seven years—on time and on budget, and in 1994 the Korean government awarded Namkung the Order of Civil Merit (Camellia Medal).

Namkung, who has been part of PAL from its beginning, has handled a range of responsibilities: professor, laboratory director, and dean of the graduate school among them. Even now he is a professor emeritus and an executive advisor to the laboratory—and running two research projects as well. The PAL-XFEL (X-ray Free Electron Laser), a fourth-generation accelerator, was approved in 2011 and finished in 2015, also on time and on budget. Namkung counts his contributions to this project, as well as to the Pohang Light Source, as his two proudest research accomplishments. From what began as essentially a pasture 30 years ago, PAL has grown to be a major scientific facility that has

attracted 38,000 users, and Won Namkung has been there from the beginning, always looking for opportunities to advance accelerator science.

“People accuse me of trying to make Korea the ‘Republic of Accelerators,’” he laughed.

He said he has many colleagues he respects who have smaller research groups, but for his own pursuits, “I’m interested in mobilizing at least a few hundred to ten thousand people.”

That explains his affinity for taking on big responsibilities. Among a long list of committees and academic activities, he was chairman of the board and president of the Asia Pacific Center for Theoretical Physics from 2016 to 2017, the same time he was chairman of the International Thermonuclear Experiment Reactor (ITER) Council.

As Namkung explained, ITER is a treaty among 35 countries to build a magnetic fusion device in pursuit of a cleaner, sustainable energy source. The ITER Project officially began in 2007 and he said there have been bumps along the path with costs and delays.

“During this chaotic time, I was chair,” he said.

He said he reset the baseline for scheduling and believes everyone is working hard to make the project successful. Despite the challenges, he’s quite proud of the collaboration.

“For me, there is really no such thing as a lost cause—an impossible task,” he said.

This attitude is obvious in his avocations as well as his research. He spent two weeks in the Himalayas earlier this year trekking to the Annapurna base camp. He has travelled to Tibet and the Silk Road—trips he dreamed of as a kid. From a child raised in post-war poverty, looking at a television on a store shelf, he followed his natural curiosity and became a big believer in preparing for, and pursuing, opportunities.

If he had one piece of advice for students, Namkung said it would be this: “Don’t be pessimistic. Someday while you are preparing, a chance may be passing by. Don’t miss that chance. Prepare well. Opportunity never stays forever.”

Won Namkung

PhD, 1977

2018 Distinguished Physics Alumnus recognized for outstanding contributions and global leadership in accelerator physics and fusion energy research

Young Alumnus Profile



Laura Cutler

Laura Cutler in a treatment room at Provision Proton Therapy Center in Knoxville

Bachelor's in Physics, Summer 2016
Medical Physics Intern
Provision Healthcare, Knoxville

What's your hometown?

I was an Air Force brat but Memphis, Tennessee, is where my family has settled.

Why did you choose to come to UT?

I loved science and math but wasn't quite sure how I wanted to use that passion so I was looking for colleges that allowed me to explore different options while still getting a great education. Not to mention I am a huge Tennessee football fan! (Go Vols!!)

What sparked your interest in medical physics?

To be completely honest, Google. Like I'm sure most physics majors do at least once, I typed "what can I do with a degree in physics?" and the rest is history. I love interacting with people and the idea of using my degree to impact lives so directly seemed like an incredible opportunity. I was interested enough that I started emailing as many people that I thought might have suggestions for how to learn more.

What are the requirements for a master's in medical dosimetry?

In order to complete my master's in medical dosimetry, I am required to take 45 graduate level hours and complete at minimum 720 hours of a clinical internship. Before graduation I must also submit a summary journal about various aspects of clinical practice as well as a research project, which we are encouraged but not required to publish in a journal.

I am also in the process of completing my master's in medical physics for which many of my classes will overlap, but the program on its own has a similar course load and internship requirement. The primary

difference is the residency requirement for a medical physics graduate to become a “certified” medical physicist. Typically these residencies last 1-2 years and will allow me to sit for the 3-part certification board exam.

How was a physics education helpful?

My background in physics gives me a unique perspective coming in to the dosimetry program where a majority of students come from working in x-ray or radiation therapy departments. They are more familiar with the application/administration of everything we are studying where I definitely have more comfort with the theory and science behind what is happening during a treatment. We work to bridge the gaps in understanding and I really enjoy being able to share my perspective.

In the medical physics program, my background in physics is extremely helpful. Understanding particle level interactions and being able to problem-solve is absolutely essential. Quick shout out to my Modern Physics lab professors for everything they taught me about Compton scattering!! So thankful to you, Kate Jones and Christine Cheney!

What are your responsibilities as an intern?

Being in a dual program, I go back and forth between different types of tasks. On the dosimetry side, I work to help the treatment planners with workload, especially on less complex cases. (Also) drawing structures on CT scans so that the computer can recognize them as well as giving the computer radiation dose objectives to meet and adjusting when necessary in order to steer it toward an optimal treatment plan.

On the physics side, I assist in performing machine QA and run occasional tests on various projects meant to learn more about how to improve our treatment planning and delivery.

What do you hope to do when you complete your internship?

My dream would be to work in a proton clinic specializing in pediatric cases.

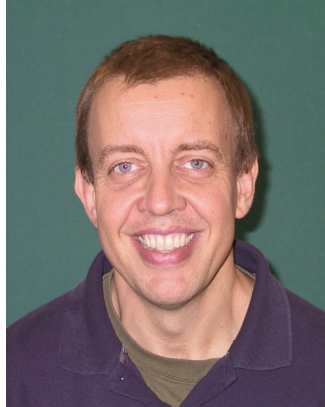
What advice would you give students who want to pursue medical physics?

I would definitely encourage them to give consideration to why they are interested. It is so important that medical physicists and dosimetrists care enough about the patients that they are completely committed to providing the best care possible. After this, I would recommend contacting a medical physicist at a local clinic or hospital to help guide them. All it took was a few emails and I had a team of people behind me supporting my effort to pursue this career.

“ In the medical physics program, my background in physics is extremely helpful. Understanding particle level interactions and being able to problem-solve is absolutely essential. Quick shout out to my Modern Physics lab professors for everything they taught me about Compton scattering!! So thankful to you, Kate Jones and Christine Cheney! ”

—Laura Cutler

Faculty Accolades



From left: Cristian Batista, Hanno Weitering, and Haidong Zhou. Their research on quantum materials, two-dimensional high-temperature superconductivity, and control of metal-insulator transitions helps advance UT's research goals.

Professor and Lincoln Chair of Excellence Cristian Batista's proposal for **Quantum Materials for Future Technologies** is one of two chosen for final review in the university's next round of cluster hires. The proposed work would connect researchers across disciplines to develop quantum technologies in materials engineering, condensed matter physics, computer science, and quantum information. The hire would synchronize with high-performance computing facilities at Oak Ridge National Laboratory.

UT launched an initiative last year to establish transdisciplinary research clusters with the aim of enhancing the university's reputation for research excellence that addresses societal challenges, especially those important to Tennessee. The cluster hires program adds faculty in specific areas of expertise to build bridges between departments, schools, and colleges.

The first cluster hires will be in data sciences. Batista's proposal is one two (the other is for a Center of Food and Activity for Healthy Communities) selected for final review to be the second cluster hires.

Professor Hanno Weitering and **Assistant Professor Haidong Zhou** have won funding from the university's Office of Research and Engagement 2018 Research Seed Program. Weitering's project is **Unraveling High-Temperature Superconductivity in Two Dimensions**, while Zhou's is **Toward Operational Control of Metal-insulator Transition with Tunable Symmetry-Breaking Strain**. The seed program began last fall with the goal of generating proposal submissions with specific sponsors or research initiatives in mind.



Professor Soren Sorensen has been named a Chancellor's Professor for the upcoming academic year. Six UT faculty members were selected for the honor based on their distinguished records in teaching, research, and university service.

Sorensen came to UT in 1985 and, as his Chancellor's Professor biography states, "excels as an advisor for graduate students and was honored as Teacher of the Year in 2008 and 2013 by the Society of Physics Students. (He) is also the chair of STRIDE (Strategies and Tactics for Recruiting to Improve Diversity and Excellence) and is passionate about educating the campus community on bias and diversity. He is a successful researcher who has produced more than 270 refereed papers that have been cited more than 15,500 times. Sorensen also plays an integral role at CERN, the European Organization for Nuclear Research, which recognizes UT as a top research institute and provides research opportunities for our students and postdocs." In 2016 he was honored as Macebearer, the university's highest faculty honor. He also served as head of the physics department for 12 years.

Eirik Endeve (pictured right with his certificate), a joint faculty assistant professor, was named one of three Undergraduate Research Mentors of the Year in the College of Arts and Sciences. Endeve, who works at Oak Ridge National Laboratory as a computational astrophysicist, won the praise of several students, who extolled his sound advice for conducting and presenting quality research, his teaching ability, and his encouragement.



In fact, Endeve worked with physics major **Brandon Barker** on “Prospects for High Energy Followup Studies of Gravitational Wave Transients,” presented at the Exhibition of Undergraduate Research and Creative Achievement (**EURēCA**). The event is sponsored by the Office of Undergraduate Research. Students enter their undergraduate research, senior design projects, clinical projects, and creative achievements for judging. Barker and **Taylor Stevenson** each won a silver award.

Stevenson’s research was on “Nucleosynthesis in Core-Collapse Supernovae,” with **Joint Faculty Professor Raph Hix**. Barker also won an award in the College of Arts and Sciences, Natural Sciences Category—Stevenson was recognized with an Honorable Mention in the same.

Chancellor’s Honors

Each spring the Chancellor’s Honors Banquet recognizes students, faculty, staff, and friends for their extraordinary achievements. The 2018 physics awardees were:

Extraordinary Academic Achievement (Students)
Brandon Barker, Kevin Kleiner, and Taylor Stevenson.

Extraordinary Professional Promise (Students)
Aaina Bansal, Brandon Barker, Samuel Emmons,

Andrew Michael Lopez, Peyton Nanney, Tyler Scott Smith, and Travis Stockinger.

Research & Creative Achievement (Faculty)
Physics Professor Yuri Efremenko

Physics graduate students **Toby King, Dave McCallister, and Nathan Traynor** were also recognized at the Graduate Student Senate Awards Ceremony and Breakfast in April. King was honored for Excellence in Research; McCallister for Excellence in Service; and Traynor for Excellence in Teaching. The GSS Awards Breakfast is sponsored by the Office of the Chancellor.



Among our Chancellor’s Honors awardees were (L-R) Taylor Stevenson, Brandon Barker, Peyton Nanney, and Kevin Kleiner.

Physics Family News

Congratulations to undergraduates **Brandon Barker and Brittney Contreras** on winning scholarships from the national Society of Physics Students organization. Barker won an SPS Leadership Scholarship and Contreras won the Aysen Tunca Memorial Scholarship.



Graduate Student **Jason Bane** has won a 2018 JSA (Jefferson Science Associates) Graduate Fellowship. He will work with his advisor, **Assistant Professor Nadia Fomin**, on the EMC effect in three-body systems.

Wei Tang, a postdoc with **Assistant Professor Sowjanya Gollapinni's** group, has won a Neutrino Physics Center (NPC) fellowship from Fermilab. His primary responsibilities will be leading the detector controls and monitoring efforts for the Short-Baseline Near Detector (SBND) experiment and the data production activities for MicroBooNE, along with physics analysis activities.

Brittney Contreras, Brandon Barker



Showni Medlin-Crump



Rick Huffstetler

Showni Medlin-Crump was named Volunteer of the Year for her efforts in this year's Big Orange Family Campaign, an initiative to encourage giving among UT faculty and staff. With enthusiasm, positive messaging, and prize drawings, she played a key part in a campaign that brought the university's collective participation rate to nearly 60 percent.

The College of Arts and Sciences celebrated outstanding staff members in May and among them was **Rick Huffstetler**, who leads our machine shop. He was recognized for Outstanding Technical Support for his exemplary supervisory work, planning, designing, purchasing, and machining.

Particle Physicists for a Day

High school teachers and students were particle physicists for a day on April 21 in an international particle physics masterclass organized by **Assistant Professor Sowjanya Gollapinni** and **Outreach Coordinator Kranti Gunthoti**. Halls High School science teacher (and UT Physics grad) Erica Johnson, and West High School physics teacher Tommy Eggleston joined their students in analyzing data from the Compact Muon Solenoid (CMS) Experiment running at CERN. They analyzed a total of 440 events from CMS and found many particles in the data like muons, electrons, and W/Z bosons, but the most exciting part was certainly finding five Higgs events in the dataset!



Tommy Eggleston joined their students in analyzing data from the Compact Muon Solenoid (CMS) Experiment running at CERN. They analyzed a total of 440 events from CMS and found many particles in the data like muons, electrons, and W/Z bosons, but the most exciting part was certainly finding five Higgs events in the dataset!



Honors Day

Physics students celebrate at the Honors Day reception following the festivities. From left (back row and around): Kevin Kleiner, Taylor Stevenson, Noah Crum, Tara Skiba, Brandon Barker, Brittney Contreras, Peyton Nanney, Josh Barrow, Aaron Kirby, Chris Matteson, and Jesse Buffaloe.

The annual Honors Day event this April brought with it recognition of outstanding students, faculty, and the **2018 Distinguished Alumnus: Won Namkung**.

Dr. Namkung, who gave the Honors Day address, earned a bachelor's degree in physics at the Seoul National University in 1965 before serving in the Korean Air Force. In 1971 he came to UT as a graduate assistant, completing his PhD in 1977 (see the alumnus profile on page 4). The department recognized him "for outstanding contributions and global leadership in accelerator physics and fusion energy research."

The student honorees from the Honors Day celebration were:

Sigma Pi Sigma, Physics Honor Society inductees: **Brandon Barker, Grant Bruer, Kevin Kleiner, Sacha Purnell, Katlin Reynolds, Samuel Feldman, Justin Scott, Taylor Stevenson, and Travis Stockinger**

Outstanding First Year Student
Lara Blokland

Robert Talley Award for Outstanding Undergraduate Research
Peyton Nanney

Robert Talley Award for Outstanding Undergraduate Leadership
Peter Tarlé

James W. McConnell Award for Academic Excellence
Brandon Barker

Douglas V. Roseberry Award
Taylor Stevenson

Outstanding GTA Award
Aaron Kirby

Outstanding Tutor Award
Jesse Buffaloe

James E. Parks Award
Nathan Traynor

Colloquium Award
Shashi Pandey

Stelson Fellowship for Beginning Research
Michael Sandoval

Stelson Fellowship for Professional Promise
Matthew Frost

Fowler-Marion Award
Aaina Bansal

Wayne Kincaid Award
Jay Carroll

Society of Physics Students Teacher of the Year Award
Maxim Lavrentovich

Learn about the names behind our awards, see the 2018 photo album, and read details about this year's awardees at:

phys.utk.edu/news/2018/spring-honors.html





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Department of Physics & Astronomy

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Look closely and you'll see a seed of curiosity in that tree. As part of the Society of Physics Students' commitment to enriching local K-12 education, we host a number of STEM outreach programs. Our Space Exploration and Rocketry program teaches the basic physics behind how rockets work—from the vehicles that will propel us to Mars and beyond to model rockets that these budding scientists and engineers build with us. Yet the history of space exploration is littered with missions that did not go quite to plan. From these lessons we learn how to innovate, adapt, and come up with the big ideas to reach for what lies beyond our skies.

(Photo and text courtesy of UT SPS President Peter E. Tarlé)



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CrossSections

