Department of Physics and Engineering
2020-2021 Alumni Newsletter

Featured Alumnus
Daniel Ortiz

Daniel Ortiz graduated from the University of Scranton in 2015 with a B.S. in Engineering Management and a Masters of Business Administration, Operations Management and Management Information Systems in 2016. Daniel also rowed for Scranton Men's Crew during his time at the University. After graduation, Daniel was hired by Raytheon Technologies as a member of the Operations Talent Development Program. This program provided Daniel the opportunity to rotate through three different manufacturing operations roles within Raytheon Integrated Defense Systems. During his time in the program, he gained experience managing teams of union workforce and was responsible for the cost, schedule, quality, and safety of both our product and people.

Since graduating the program, he was awarded the position of Value Stream Manager of the department's Integrated Test Automation System & Radio Frequency Subassembly areas. In this role, Daniel manages a team of four cell leaders across five work centers, maintaining a focus on product cost, schedule, and quality for radar defense weaponry.

"I'm thankful for the challenging curriculum and supportive staff at the U. Both pushed me to think critically and learn how to be an effective problem solver."

Outside of his career, Daniel has come to enjoy the world of real estate investing. He currently owns a two-family property and plans to purchase a second property in the coming year.

Daniel was 7 seat (second from right) for Scranton Men's Crew

Francis Lynch – Business Leadership Honors Program

Francis Lynch, a junior in the University's Electrical Engineering program, has recently been accepted to the University of Scranton's Business Leadership Honors Program. The Business Leadership Honors Program is designed to foster the development of distinguished students into the leaders of tomorrow. The program is grounded in the Jesuit ideals and promotes the principle of cura personalis through providing personalized guidance and direction in development of the entire person. Through completion of the program students will earn a minor in Leadership while enjoying unique classroom and practical learning experiences along the way. Employers are increasingly including the demonstration of leadership characteristics in job requirements and qualifications. Business Leadership students are at an advantage having completed a program focused on the understanding and practical application of leadership theories and the development of personal leadership abilities. Further, the program emphasizes the ideal of "Eloquentia Perfecta," which stresses the development of the critical leadership skill of strong communication. The rigorous curriculum and small group size promotes a challenging, yet rewarding learning environment where friendships and professional relationships are developed.

The program stresses ethics, service, freedom of inquiry, and personal development. The leadership lessons that Business Leadership students learn in the classroom are supplemented and reinforced by interactions with business executives, mentors, and service projects. Students gain experience working within a team during annual consulting projects which are presented to distinguished faculty and alumni. Business Leadership graduates have been successful in obtaining internships and on average receive higher starting salaries than their peers at The University of Scranton.

Hossein Banitabaei - New Faculty

Dr. Hossein Banitabaei received his B.Sc. and M.Sc. in Mechanical Engineering from Amirkabir University of Technology in Tehran. He was also awarded a scholarship by AUT to study as a double-major by which he earned a second B.Sc. in Industrial Engineering-Management & Systems Analysis. His research was focused on experimental and numerical study of multiphase flows, particularly the geometry optimization of wave-plate mist eliminators in industrial cooling towers in order to reduce the pressure loss and enhance their efficiency.

In 2009, in addition to teaching at AUT, Dr. Banitabaei joined Laser Interferometry Laboratory at the University of Tehran where he worked and published on a variety of research projects.

In 2014, he started a position at the Surface Engineering and instrumentation Laboratory (SEiL) at York University in Toronto. During his Ph.D. program, Dr. Banitabaei focused on surface fabrication and studying the impact of droplets onto superhydrophobic particles in mid-air using high-speed imaging techniques and simulation methods. During this time, he was involved in several other research projects from food industry to collaboration in developing educational kits for children. Later, he joined B.C. Research Inc. in Vancouver for a joint postdoctoral fellowship with the University of British Columbia where he worked on developing a gel used for oil containment in spill incidents.

Dr. Banitabaei has published several papers in reputable peer-reviewed journals including a Featured Article in Physics of Fluids and in Scilight (Scientific Highlight), presented his research findings in a number of international conferences, and received several scholarships, awards, and fellowships. His research interests include fluid dynamics and interfacial phenomena utilizing experimental techniques and numerical simulation methods. He also serves as a reviewer for the American Physical Society. Dr. Banitabaei has recently joined the University of Scranton as an Assistant Professor in Physics and Engineering Department. He is also a member of the Canadian Society for Mechanical Engineering (CSME) and Ontario Coalition Against Poverty.

Rachel Frissell – New Faculty

Rachel Frissell earned her Bachelor of Science in Physics from the Robert E. Cook Honors College at Indiana University of Pennsylvania. During her time there, she was awarded the Dean's Scholarship for Natural Science and Mathematics as well as a Board of Governor's Scholarship.

After graduation from IUP, she attended Virginia Tech where she earned her Master's of Engineering in Materials Science and Engineering. She worked on the fabrication and characterization of III-V semiconductor devices. Following her time at Virginia Tech, she worked as a Process Engineer at SRI International in Princeton, NJ where she was the primary engineer on the physical vapor deposition tools of Trikon Sigma 200 and Sigma fxp.

After two years at SRI International, Rachel joined the Center for Solar-Terrestrial Research group at the New Jersey Institute of Technology to pursue and earn a Master's of Science in Applied Physics. She studied geomagnetic field observations from Antarctica and presented her work at various conferences.

Physics Research Projects

The superlattice (SL) effect on current increase in Graphene/Oxide/n-GaAs Schottky Barrier Solar Cells

Presentation at the 37th European Photovoltaic Solar Energy Conference and Exhibition (PVSEC) International Conference, Sept 7 – 1, 2020 by Dr. Argyrios Varonides

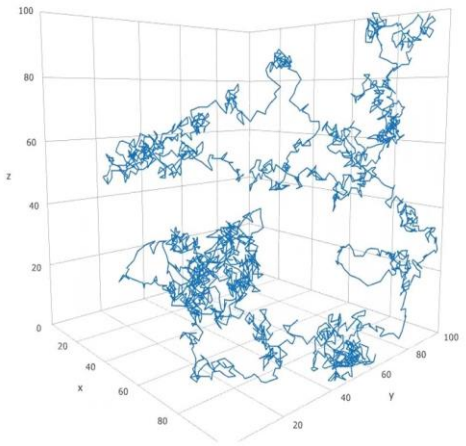
We demonstrate the advantage of current density increase in graphene/Oxide/n-GaAs solar cells by means of a short AlAs/GaAs superlattice (SL) embedded in the GaAs layer. Such a layer attracts photo-excited carriers of both kinds leading to optical gap increase from 1.42eV to 2.129eV due to ground state energy difference, leading to strong absorption at 582nm of incident solar wavelength. We study carrier escape in the thermionic emission model and find that excess carriers thermally escaping from quantum wells of the SL region contribute additional current depending on temperature and solar concentration. Specifically, a twenty-period SL region under one sun absorbs within 582nm < l < 873nm range, contributing 1.391mA/cm2 and 9.83mA/cm2 and near 20mA/cm2 at one, 50 and 200 suns, respectively.

Photon Diffusion

Dr. Declan Mulhall, Shaaf Sarwar, James Lanning, Thomas Elias, John Nelson

The intensity of light from the side of a candle decreases with distance. A model for this is photon diffusion, where the light is treated like a gas of particles that do a random walk through the medium. There is a mean free path, and a probability of an absorption. The material has scattering sites.

We are modelling this phenomenon as a diffusion of photons, treating light as a gas. We are constructing an apparatus that will measure the intensity of the light along a wax cylinder that is illuminated by our LED. It involves nontrivial data measurement and analysis, and mathematical modeling.



Quantum Chaos

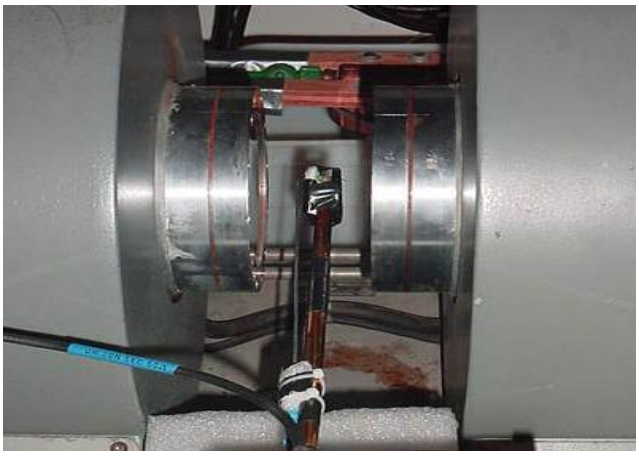
Dr. Declan Mulhall, Cuong Nguyen, Peter Bouraphael

Random matrices can model chaotic quantum systems, like the atomic nucleus, or very excited atoms. Random matrix theory is the center of quantum chaos. The results of RMT can be used for the immensely practical and important job of analyzing data from certain nuclear experiments. In this project, we would use python to make random matrices, look at their properties, and then analyze data from Brookhaven National Laboratory.

Nuclear Magnetic Resonance

Dr. Declan Mulhall, James Lanning, Aidan Szabo

We are designing a continuous wave nuclear magnetic resonance apparatus to measure the tiny absorption of RF energy by the protons in a sample. The sample is a tiny bottle of oil or water, in a small coil put in the poles of a magnet. E challenges here are making an oscillator circuit, simulating it on LTspice, and then designing the PCB.



Internships, REUs, and Graduate Schools

Graduate School

Joseph Delmar PHYS - Temple University, Particle Physics
Camille Mikolas PHYS - Michigan State University, Physics
Jesse Kemmerling CE - Penn State University, CE
Andrew Charway CE - Lehigh University, E/CE

Internships

Brain Kroll ’22 EE – SMART Program - Electrical Engineering Technician, Engineering Directorate Tobyhanna Army Depot
Ellie Rosentel ’22 EE – Miller-Rosentel Assoc., Wilkes Barre, PA
Nicholas Voltaggio ’20 EE - Johnson Controls, New Freedom, PA
Eileen McNulty ’20 EE – TREC Group, Inc – Springfield, PA
Stephanie DeBarros ’20 CE – IT Services, LLC, Stamford CT
Vincent Oliverio ’20 CE – US Air Force, Wright Patterson AFB
Andrew Buttner ’20 CE – Saab Sensis, Syracuse NY
Joseph Brancato ’20 EM – Tishman Speyer, New York, NY
Mark Pawelski ’20 EE – Toyhanna Army Depot, Tobyhanna, PA
Matthew Slezak ’20 EE – Enersys, Reading PA
Quinn Killeen ’20 CE – Syska Hennessey Group, New York, NY
John Radetich ’20 EE – Pride Mobility, Duryea, PA

Research Experiences for Undergraduates

Francis Tholley ‘21 – Penn State University
Victoria K. Norman ’19 – University of Arkansas-Fayetteville.

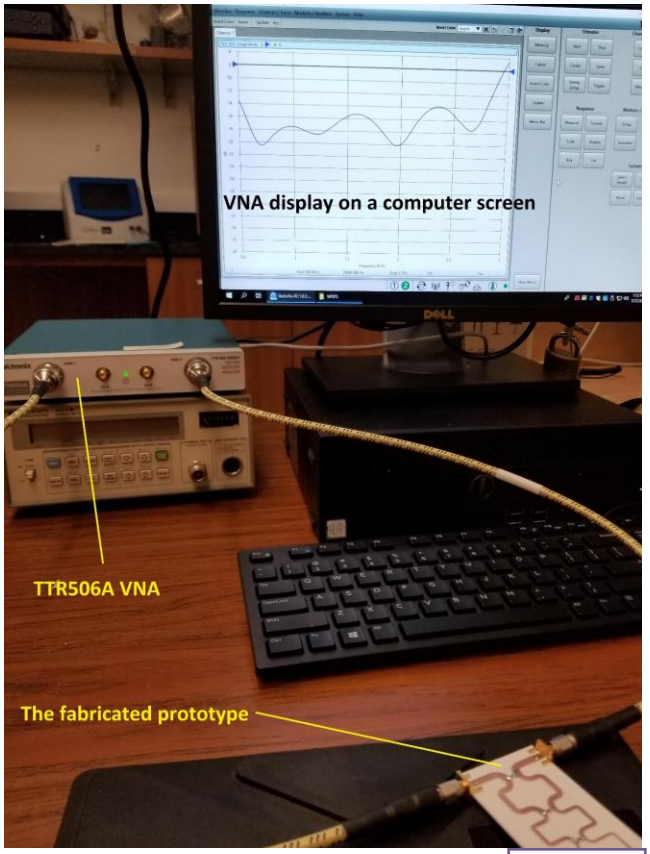
Engineering Research Projects

A New Analytical Design Methodology for A Three-Section Wideband Wilkinson Power Divider

Mohammad A. Maktoomi, Zeba N. Zafar, Hussain Al-Shakhori, Christine Zakzewski, and Aubrey N. Savage

A new analytical design technique for a three-section wideband Wilkinson power divider is presented. The proposed design technique utilizes the dual-frequency behavior of commensurate transmission lines for the even-mode analysis and contributes a set of completely new and rigorous design equations for the odd-mode analysis. Measurement of an in-house fabricated prototype utilizing the proposed technique shows an excellent return-loss (> 20 dB), insertion loss (< 3:25 dB), and decent isolation (minimum: 14 dB) with bandwidth extending beyond the minimum requirements.

A research paper based on this work is currently under review in the Progress in Electromagnetics journal.



The Thomas N. Tate, Esq. '56 Collection of Aerospace Memorabilia

University of Scranton alumnus Thomas Tate, Esq. '56, spoke to students majoring in physics and engineering during his Oct. 14th visit to campus and toured the exhibit "New Frontiers: The Thomas N. Tate, Esq. '56 Collection of Aerospace Memorabilia," which he donated to the University.

The collection of items accumulated during his service with the national aerospace program from 1962 through 2003 was displayed in the new 5,300 square-foot, state-of-the-art learning and laboratory space for the Mechanical Engineering program on the first floor of Hyland Hall.

"I know that with philanthropy comes promise and possibilities. I want the next generation of explorers to receive a Catholic and Jesuit education that takes them to discovering their great frontier. Together, our support can redirect their future in ways unimagined," said Tate of his donation to the University.

Tate also spoke to University students at The Institute for Electronics and Electrical Engineering Seminar Series about his personal experience with the aerospace program, which included work on the Gemini, Apollo and Space Shuttle initiatives.

A native of Olyphant, Tate received his bachelor's degree in marketing from the University in 1956. His distinguished career spanned four decades, during which he held positions with Rockwell International for 12 years; the federal government, serving on the House of Representatives' Committee on Science and Technology for 15 years; and an advocacy group, working for the Aerospace Industries Association for 17 years.

His collection will have a permanent home in the mechanical engineering facility in Hyland Hall. The renovated space includes three laboratories, a workshop, a machine shop, and a 16-seat computer lab, as well as faculty offices and a student lounge area. In the facility, mechanical engineering students will experiment with several pieces of equipment in solid mechanics, fluid mechanics, thermodynamics, control, dynamics and vibration labs. Students, like aerospace scientists, will work with a wind tunnel, where they will determine important fluid characteristics by measuring aerodynamics pressures, forces and moments applied to aerodynamics models such as airfoil models by the airflow in laminar and turbulent flows. They will also investigate the behavior of engineering materials by performing precise tensile and compression tests to determine material properties such as strength, modulus of elasticity, yield and failure stresses of standard engineering materials.

The University of Scranton Hosts Virtual HamSCI Workshop

This past March 20-21, 2020, almost 300 people from 6 continents gathered on Zoom to participate in HamSCI 2020: The Auroral Connection, a workshop dedicated to studying space physics, space weather, and radio propagation through a collaborative effort of both the professional geospace and the amateur radio communities.

This NSF-sponsored workshop, led by Scranton Assistant Professor Dr. Nathaniel Frissell, featured invited talks by Dr. Elizabeth MacDonald (Aurorasaurus/NASA) on optical auroral signatures, Dr. Jim LaBelle (Dartmouth College) on natural radio auroral emissions, and David Hallidy K2DH on amateur radio auroral communications. In addition, this workshop served as a biannual team meeting the HamSCI Personal Space Weather Station project, a $1.3 million collaborative NSF project led by Dr. Frissell to develop new ground-based instrumentation for citizen space science. As part of this effort, University of Scranton Senior Electrical Engineering student Jonathan Rizzo presented a paper on the development of a receiver for detection and study of Very Low Frequency radio emissions.

Although this HamSCI workshop was originally supposed to by held in-person on Scranton's campus, it became one of the first science workshops to effectively transition to a virtual format as a result of the COVID-19 pandemic. A complete video recording of HamSCI 2020 is available from hamsci.org/hamsci2020. The HamSCI 2021 workshop will again be hosted virtually by the University of Scranton in March 2021. Please join us! For more information, please visit hamsci.org or e-mail nathaniel.frissell@scranton.edu

NSF Collaboration Grant

Dr. Frissell brings with him a 3-year NSF grant entitled "Collaborative Proposal: DASI Track 1: Personal Space Weather Station." It is a collaborative proposal (now) between The University of Scranton, University of Alabama, Case Western Reserve University, and the TAPR Amateur Radio Electrical Engineering Organization. The goal is to create a small device that people can install in their backyards to measure local effects of space weather, and then send those observations back to a central server to allow analysis on global scales. We are interested in understanding short-term and small-scale variability in the ionosphere and magnetosphere.

Scranton's Newest Club: W3USR Amateur Radio Club

One of The University of Scranton's newest student organizations, the W3USR University of Scranton Amateur Radio Club, was voted to become an official club by the University of Scranton Student Senate on September 4, 2020. Amateur (ham) radio is a hobby that is officially recognized by the U.S. Federal Communications Commission (FCC) as having the fundamental purpose of providing volunteer public service and emergency communications, advancing the state-of-the-art of radio technologies, expanding the pool of trained radio operators, radio technicians, and electronics experts, and enhancing international goodwill. W3USR is the official radio callsign issued to the club by the FCC.

Even in the midst of the COVID-19 pandemic, W3USR has been highly active with regular meetings on Zoom. Thanks to online radio platforms such as kiwisdr.com and Echolink, club members have been able to remotely access shortwave listening facilities and VHF/UHF communications systems around the globe. Collaborations with other university clubs such as New Jersey Institute of Technology K2MFF, Massachusetts Institute of Technology W1MX, and the Case Western Reserve University W8EDU have allowed for Scranton students to earn new and upgraded amateur radio licenses remotely. Zoom has also enabled the W3USR Scranton club to regularly host world leaders in amateur radio and ionospheric science as guests at club meetings. Planned activities for the Fall 2020 semester include guided building of the Elenco AM-780k radio kit, talks on the history of Heinrich Hertz by Dr. Ted Simpson and Amateur Radios by Mr. Bill Liles NQ6Z, an intercollegiate Short Wave Listening Contest.

The W3USR Amateur Radio Club is led by President Veronica Romanek KD2UHN ('23, Physics), Vice President Jonathan Rizzo KC3EEY ('21, Electrical Engineering), Secretary Tommy Baran KD2SNG ('23, Neuroscience), Treasurer Steve Holguin ('22, Computer Engineering), and Faculty Advisor Dr. Nathaniel Frissell W2NAF. Zoom club meetings are held Thursday at 8 PM and open to all interested. Please contact the club secretary at thomas.baran@scranton.edu for more information.

Physics Summer Camp

High school students were introduced to the extraordinary world of physics at a summer camp hosted at The University of Scranton. The three-day camp for 9th and 10th grade high school students, taught by University physics faculty members, included mini-lectures and hands-on activities to introduce basic physics concepts of electricity and magnetism, as well as dramatic real-life examples of these principals in action.
At the camp, which took place July 19-21, 12 high school students learned about types of waves, oscilloscopes, magnetic coils, loudspeakers and software defined radio. They built a generator, a motor, and learned to use cutting edge Software Defined Radios (SDR). They installed and got to keep an actual SDR to use at home.

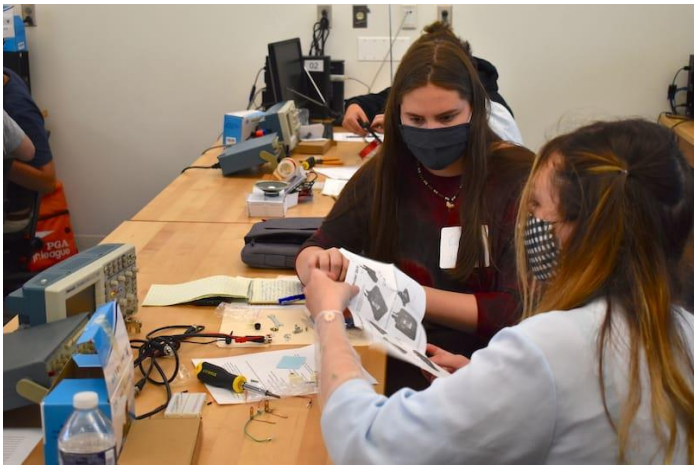
The students were also introduced to an array of much-in-demand careers available to physicists, or "supercharged engineers," as the profession is described by Declan Mulhall, Ph.D., professor of physics and engineering at Scranton.

"Physicists have a depth of knowledge and training to give them a broad understanding of a subject and are able to apply their training to find solutions to complex problems and issues," said Dr. Mulhall, who was among the faculty members leading the camp. "People always have to learn new technology to enter the workforce because of technological advances. Physics – and to some extent engineers – are the source of those advances, and we are training future physicists."

According to the U.S. Bureau of Labor Statistics, the job outlook physicists and astronomers is projected to grow seven percent from 2019 to 2029, faster than the average for all occupations. The median annual wage for physicists was $129,850 in May 2020.

Dr. Mulhall said graduates earning a bachelor's degree in physics work in a number of industries. Recent graduates of the University are working as industrial physicists at Collins Aerospace, optical systems designers at Thorlabs, as well as pursuing graduate studies in physics or astrophysics. "One student is working on cutting edge quantum computers at Michigan State University. She reports loving it," he said.

Dr. Mulhall noted that University of Scranton students have access to a broad range of physics laboratory equipment, such as the torsional oscillator. The basic principles learned through experiments with this piece of equipment can be applied to all areas of physics where vibration happens, from how light goes through glass but not paper, to the design of bridges and skyscrapers.
The summer camp was offered free of charge to participants through support from the University's Department of Physics and Engineering and a National Science Foundation grant.



Thank you for reading our 2020-2021 Physics/Engineering newsletter! Feel free to contact any of us at any time!

Dr. W. Andrew Berger

Department Chair

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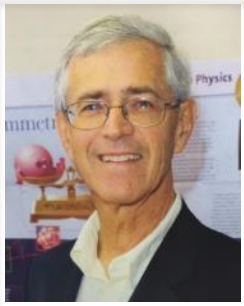

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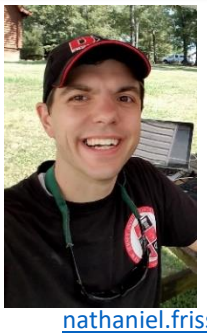

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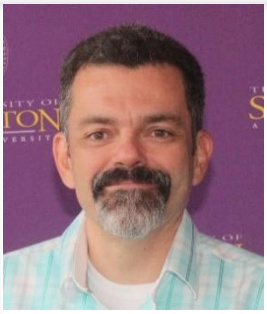

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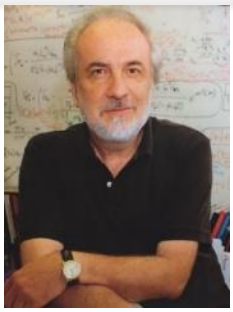

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