We had a very active year in the Physics, Geology and Engineering Technology department.

For starters, we hired two new faculty to the department. Zeel Maheshwari, formerly a post doc at Oklahoma State University, joined the department this fall as an assistant professor in engineering technology. Zeel’s area of expertise is renewable energy and power systems. Zeel received the department’s first Dorothy Westerman Hermann endowed professorship in Science. And Nilesh Dixit, formerly a post doc at University of Alaska, Fairbanks, joined the Geology program as a permanent Lecturer. Nilesh brings expertise in geophysics to the program.

This year we have seen two of our faculty recognized with awards at the university level. Scott Nutter, astrophysics professor, was awarded the faculty research award at our annual award ceremony for his research work in cosmic rays. And Nathan De Lee, astronomy professor, was recipient of the Outstanding Junior Faculty award from the College of Arts and Science.

Our observatory, which was closed for two years due to the renovation of Founders Hall, was reopened in October to the public and for use by students in astronomy classes. The planetarium had a record 13,000 attendees this year. We continue to expand our outreach and community engagements: This year, in collaboration with the Kentucky Society for Professional Engineers (Northern Kentucky chapter), our department organized a very successful Engineering Career Day that attracted about 100 high school students who are interested in engineering.

The department had one retirement this year: John Rockaway, director for the Geology program, retired after seventeen years of service to NKU and the geology program. He will be greatly missed.

We have continued to improve our curriculum by proposing new programs, creating new courses and revising existing courses. Our latest addition to the department, the Mechatronics Engineering Technology program, is thriving: a new mechatronics lab will be established to support the program.

As a department we continue our efforts in recruitment and retention. The number of majors remained at the same level as the year prior, and we hope to attract even more students to our programs. We look forward to the opportunities that are ahead for our department and would like to have the support of our alumni and the community. There is much more we can do, such as create scholarships for students, provide more research and engineering design opportunities for students, and hold public lecture series; for that, it is important that we have a sizable foundation account. So I am personally asking alumni to donate funds to our foundation account to support our initiatives. It is very easy to send funds to our department—we have provided information below as to how you can donate.

As always, we look forward to hearing from our alumni. Please feel free write to me at fernando@nku.edu—we’ll include your alumni updates in the next newsletter. And please check us out and “like” us at facebook.com/pgetnku.

Donations to the Department of Physics, Geology and Engineering Technology’s general fund should be directed to:

Physics, Geology and Engineering Technology Department Fund
(#0732301330)
Advancement Operations
Lucas Administration Center 239
100 Nunn Drive
Highland Heights, KY 41099

Please make the checks payable to NKU Foundation Inc. In the memo, please write “Physics,” “Geology,” “Engineering Technology,” or “Planetarium.”
ALUMNI ON THE MOVE

Alyson Robinson, MMET
Alyson Robinson graduated from NKU with a degree in mechanical and manufacturing engineering technology in 2016-2017 and currently works as a project manager at Ingredient Masters Inc. Alyson was instrumental in Dylan Smith getting a co-op job at the company, where he works under Alyson's supervision.

Clayton Wehrum, MMET
Clayton Wehrum graduated with a mechanical and manufacturing engineering technology degree from NKU in Spring 2018 and currently works at StandardAero as an OpEx project manager. He has provided information to EGT students for both co-ops and full-time positions at StandardAero.

Juan Correa III, Physics
After graduation, Juan commissioned in the U.S. Air Force as a space systems officer. He moved to Cavalier Air Station in North Dakota to operate a missile-warning and space-situational, awareness-phased array radar. After leaving North Dakota in 2016, he moved to Peterson Air Force base in Colorado Springs, Colorado, to operate a suite of defensive space control systems. He deployed to the Middle East from July 2017 to January 2018 as part of the Director of Space Forces staff, U.S. Central Command, where he coordinated space effects in support of Operation Inherent Resolve (OIR), Operation Freedom Sentinel (OFS) and Operation Resolute Support (ORS).

He just graduated from the Air Force Weapons School as a space superiority weapons officer. The U.S. Air Force Weapons School is the elite training ground for the top officers enlisted in their respective career fields and is the Air Force equivalent to the Navy Fighter Weapons School. He graduated December 15 and is now in Colorado Springs to operate a suite of offensive space control systems. He lives in the Colorado Springs, Colorado, area with his wife, Christie, and 3-year-old daughter, Rowan.

James Castle, Physics
James Castle graduated from NKU in 2012 with a Bachelor of Science in physics and mathematics and, upon graduation, entered into a physics Ph.D. program at the University of Kansas. He successfully defended his Ph.D. dissertation, “Hydrodynamic Flow Fluctuations in 5.02 TeV PbPb Collisions,” in 2017 and received an honors distinction. James currently works at the University of Kentucky’s Markey Cancer Center as a postdoctoral scholar studying the epidemiology of breast cancer. In the future, James plans to apply to the University of Kentucky’s radiological medical physics program in hopes of becoming a medical physicist.

Derek Iles, Geology
In 2014, Derek entered NKU’s Geology program with only the vague goals of wanting to work outdoors and to have an interesting career after college. This program helped jumpstart his path to a career with the federal government, first with the U.S. Forest Service in Juneau, Alaska, and now with the U.S. Geological Survey in Tampa, Florida. The faculty and classes within the Geology department helped equip him with skills necessary to obtain meaningful employment after college. He attributes much of his success to the opportunities he had through credit-earning internships while working toward his degree. His current position as a hydrologic technician allows him to work outdoors collecting important water science data in southwest Florida. While doing a mix of discharge measurements and water quality data collection, he often gets to explore beautiful areas of Florida that are rarely seen by the public. He encourages students to consider geology as it helps begin journeys to exciting careers in the natural sciences.
Prof. Scott Nutter works on high-flying science. ISS-CREAM and HELIX are NASA-sponsored instruments that measure various characteristics of near-light speed elementary particles and elemental nuclei from outside our solar system—in contrast to the large high-energy physics experiments at CERN and Fermilab, which operate from dedicated facilities, high-energy astrophysics actually goes into the field. The instrumentation must be smaller than a minivan so it can be sent into space to study these particles from outside the solar system (cosmic rays) and measure their characteristics before they interact with our planet and its atmosphere. This is accomplished with either high-altitude balloons launched from the wind-blown deserts of Antarctica or the wilds of Canada, or by sending instruments to the International Space Station.

The results teach us details about how cosmic rays accelerated to such high energies, as well as reveal various parameters—such as the propagation time scale, interstellar matter density and magnetic field strengths—associated with the tortuous journey through interstellar space between the acceleration site (believed to be primarily supernova remnants) and Earth.

The ISS-CREAM (Cosmic Ray Energetics And Mass on the International Space Station) instrument launched to the Space Station in August 2017 and will collect data for at least three years. The instrument, which is about the size of a refrigerator and has a mass of 1500 kg, was designed to measure different elements in cosmic rays at energies where it is thought the acceleration mechanism in supernova remnants begins to reach its limit. NKU helped design and characterize a scintillation detector for ISS-CREAM that will augment the science of the project by enabling identification of cosmic ray electrons, a rare but important component of the cosmic particle flux.

The launch garnered regional attention in the press, with articles in the Cincinnati Enquirer and the Northerner, TV news spots on Channels 9 and 12 and a feature article in the 50th anniversary edition of NKU Magazine.

Dr. Nutter serves as the simulations and analysis lead on this project. He built a detailed computer model of the instrument, essential in the interpretation of the data, to carefully match various detector responses to beam test data taken at CERN (the world’s highest-energy particle accelerator in Geneva, Switzerland).

HELIX (High Energy Light Isotope eXperiment) is designed to measure the relative abundance of isotopes of beryllium in the cosmic rays at intermediate energies using a magnetic spectrometer. One of the beryllium isotopes is naturally radioactive and, thus, an important measure of time elapsed since production and acceleration. A 1-Tesla superconducting magnet bends through-going cosmic rays differently according to their charge and velocity, which measures momentum. Other detectors measure particle charge and velocity, providing enough information to determine the mass (i.e. isotope) of cosmic ray particles.

This project started in 2015, and a high-altitude helium balloon space launch is scheduled for summer 2019-2020 in Antarctica. The team from NKU will participate in simulations, as well as design and fabricate the Bore Paddle (BP), a small scintillator paddle that fits into the central region of the magnet and reduces background by providing a trigger activated only by particles going through the magnet bore, or center.

Students are designing, fabricating and testing instrumentation, essential components of simulation efforts. Recent student research assistants include Carter Kring (BS PHY 2018), Brian Butler (BS MAT 2017), Breanna Kenworthy, Tyler LaBree and Tyler Straight. In summer 2018, two computer science students, Brent Schleper and Tobel Atnafu, participated in the ISS-CREAM project under the tutelage of Prof. Maureen Doyle and wrote many of the tools now used in the analysis.
On October 20, 2018, the NKU Schneider Observatory held its grand re-opening as part of NASA’s “International Observe the Moon Night.” The NKU Schneider Observatory is named for NKU alumni Julie and David Schneider, and was originally dedicated on August 26, 2015. It was closed for more than two years during the renovation of Founders Hall and construction of the Health Innovation Center. The grand re-opening was attended by 45 people, who participated in activities such as an observatory tour, a lecture about the moon and an activity involving building a moon phase calculator. Although there were some clouds that night, several groups were able to view the moon, some planets and a multi-colored double star system.

The observatory is a 1,000 square foot facility located on the roof of Founders Hall. The roll-off roof observatory can house up to eight telescopes, and its current complement is six 8-inch telescopes, one 11-inch telescope and one 14-inch telescope. The purpose of the observatory is three-fold. The first to aid in teaching our astronomy curriculum; this can include observing nights, labs and observing skill development. The second purpose is research—the 14-inch and 11-inch telescopes can be outfitted with a digital camera and scientific filter set for precise imaging of stars, and our upper-level astronomy classes and student researchers use the equipment to study a wide variety of astronomical phenomena, including exoplanets and variable stars. The final purpose of the observatory is community outreach. The location of the observatory on top of Founder’s Hall puts the observatory above many campus lights, but it remains easily accessible for NKU students and the public. Plans are underway to combine observing nights with free planetarium shows currently offered at the NKU Haile Planetarium.

The Schneider Observatory Grand Re-opening

By the Numbers

- 6 8-inch telescopes
- 1 11-inch telescope
- 1 14-inch telescope
- 1,000 square feet

Schneider Observatory

B.S. in Mechatronics Engineering Technology Program

The new B.S. in Mechatronics Engineering Technology (MET) program was approved by the Kentucky Council on Postsecondary Education during the summer semester of 2017, and it was first made available in the university catalog for the academic year 2017-2018. Currently we have nine students enrolled in the program, and an enrollment increase is expected as the program is promoted in our region.

The term mechatronics was first used in the late 1960s by a Japanese electric company to describe the comprehensive study of electromechanical systems that integrates electrical, mechanical and computer engineering areas. Mechatronics can be defined as the analysis, design and integration of mechanics with electronics through intelligent computer control. Availability of graduates in mechatronics engineering technology will help the industry identify and reduce critical competency gaps, as well as comply with industry requirements for professionals with interdisciplinary thinking. The aim of the program is to graduate professionals who can perform in the areas of automation, robotics and controls.

There are currently very few mechatronics B.S. programs in our area. To enhance NKU’s new program, Rockwell Automation will provide equipment for the programmable logic controller (PLC) lab at a substantially discounted price, with NKU/CAS matching the investment. A classroom located in the Business Academic Center will be remodeled to serve as a temporary location until funds are secured to renovate a permanent, 20-seat facility.

For additional information on the MET program, please contact Dr. Morteza Sadat-Hossieny (sadathossien@nku.edu) or Dr. Mauricio Torres (torresm1@nku.edu).
Haile Planetarium is an active member of the Physics, Geology & Engineering Technology department, with 363 shows and 13,300 visitors last year. The majority of Haile’s visitors come as part of K-12 field trips through Community Connections, which partners with schools in the tristate area to bring K-12 students to campus. A typical field trip includes an introduction to campus and a tour of NKU, and culminates with a visit to the planetarium. Over 5,500 students come each year as part of this program, and the number keeps growing. This is one of our department recruitment tools.

Another way Haile contributes to the department is through public Friday evening shows, which recently increased in frequency from two per month to two per week. This brought with it a large increase in attendance, from 700 the previous year to almost 3,500 last year—word is getting out about our public shows in the community. But it’s not all new visitors, as a lot of regulars now come to the public shows. Having regulars is a good indication that the shows are up to people’s expectations, and they enjoy coming repeatedly.

The planetarium serves not only the community but also NKU, doing shows for several dozen groups across campus in the past year. Besides astronomy classes, the planetarium has hosted shows for a variety of physics, geology, integrative science and biology classes, as well a German class, an English class, the French club, the African Student Union and a fraternity.

Recent improvements to the planetarium have served to further enhance the experience. Offering birthday parties and opening a gift shop that sells meteorites have brought in enough revenue to hire several students as part-time planetarium lecturers to give the Friday night public shows, birthday parties and evening shows. They fill in whenever needed and are central to the expansion of public shows. Haile has recently added several new shows, too, including two for physics classes about Newton’s laws and Kepler’s laws; one about flight titled “Flight Adventures”; and one about the human eye titled “Seeing.”

Despite all the recent improvements, unmet needs remain, including new computers to replace machines last updated in 2011 and an upgrade to the original projector from 2007, which isn’t expected to last much longer. Haile is currently seeking funding to upgrade the planetarium with the new computers, the most recent Digistar planetarium software and new projectors. If you would like to donate to the crowd-sourced funding project to maintain and improve the planetarium, please visit impact.nku.edu/planetarium.

Haile Planetarium is available to any group that would like a private show. For shows done during working hours, there is no cost (except parking). For an evening or weekend show, the charge is $20. To schedule a show for a group of up to 61 people, email planetarium@nku.edu for the details.
**FACULTY AWARDS**

**NATHAN DE LEE**
Nathan De Lee received the 2018 College of Arts & Sciences Outstanding Junior Faculty Award for his significant contributions in teaching, research, service and outreach. His internationally recognized research in astronomy and his exceptional record of achievements bring great honor to our university. His teaching inspires our students. And his outreach and community service have created interest in astronomy in the region. Congratulations, Dr. De Lee!

**SARAH JOHNSON (GEOLOGY)**
This past year Sarah Johnson collaborated with eight students and Dr. Hongmei Wang to identify and catalog mass movements in northern Kentucky. Using digital elevation maps derived from LiDAR surveys of Kenton and Campbell counties from 2007 and 2012, they were able to identify over 100 landslides, 90 percent of which had not previously been reported. The results of this research have been presented at national and regional Geological Society of America meetings, at the Kentucky Academy of Science's annual meeting and at NKU’s Celebration of Student Research and Creativity. The landslide maps they created have also been published by the Kentucky Geological Survey in the recently re-mapped geologic quadrangles of northern Kentucky. This work was made possible by nearly $18,000 in CINSAM and Faculty-Student Collaboration grants, most of which went to student support.

In addition to her work on landslides, in the fall of 2018 Sarah began working with faculty from the University of Kentucky on the neotectonics of the Tetons, and with the Kentucky Geological Survey on other digital terrain analysis projects in Kentucky. This fall Sarah also started as the Geology program director at NKU. She enjoys teaching geology students, working with geology faculty to improve facilities, developing research opportunities, and connecting with businesses and graduate programs in the region.

**TRENT GARRISON (GEOLOGY)**
Geology students Constance Brown and Dan Martin participated in a study with Dr. Trent Garrison in summer of 2018 to determine connectivity between a large sinkhole on the University of Kentucky’s campus to waters at Mystery Spring, 1.5 miles away on the west side of Lexington. Results were submitted to NKU’s ISRCA Journal of Student Research and will be presented at the Kentucky Academy of Science’s annual meeting in November. A research consortium was established between the University of Kentucky, Kentucky Geological Survey and Northern Kentucky University.

**SHARMANTHIE FERNANDO (PHYSICS)**
Dr. Sharmanthie Fernando continued to work on research related to black holes and cosmology. She published a paper, “Massive Gravity With Lorentz Symmetry Breaking: Black Holes as Heat Engines,” in the journal Modern Physics Letters last year (Modern Physics Letters A 33 (2018), 1850177). Dr. Fernando had two research students, Emily Frame (black holes) and Jack Shannon (cosmology), working on projects. They both presented their work at the Heather Bullen Celebration of Research event in Summer 2018.

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**Program Director John Rockaway Retires**
This past spring, Dr. John Rockaway retired after 17 years of serving as director of NKU’s Geology program, capping off a combined 50 years of teaching at both NKU and University of Missouri in Rolla. He inspired many of our alumni to become geology majors through his classes, stories, field methods course in Colorado, love of geology and well-timed desk kicks. He kept an open-door policy and unfailingly welcomed students to chat about geology or anything else that was on their minds. In retirement, he plans to divide his time between visiting grandkids, recreating at his summer house in Michigan and finding new opportunities to explore.

The photo (right) is from Dr. Rockaway's retirement party at Skyline in May 2018. We can only hope he misses us as much as we miss him!

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Jack Shannon (left) presenting work on cosmology. Emily Frame presenting work on black holes.
FACULTY AWARDS

SCOTT NUTTER

Scott Nutter received the 2018 Excellence in Research, Scholarship and Creative Activity Award. He is one of the most productive scholars at NKU and an internationally recognized authority in experimental astrophysics; he has a stellar publication record and is highly cited. He is heavily involved in international collaborative research groups building instruments to measure the properties of cosmic rays. These research groups launch high-altitude balloons from Antarctica into space, as well as send instruments to the International Space Station. Dr. Nutter’s research projects are funded through NASA, and he has received over $1.17 million in external grants since joining NKU. Dr. Nutter takes NKU’s commitment to student success very seriously and has mentored 31 NKU students in his astrophysics lab. Congratulations, Dr. Nutter!

NEW FACULTY

ZEEL MAHESHWARI

Dr. Zeel Maheshwari earned her bachelor’s degree in electrical and electronics engineering from India’s Visveswaraya Technological University in June 2011. She completed her masters and PhD degrees in electrical and computer engineering at Oklahoma State University (OSU) in December 2013 and December 2017, respectively. Her dissertation is titled “A Study of Smart Integrated Renewable Energy Systems (SIRES)” and explores the smart utilization of several renewable resources in an integrated fashion, matching resources and needs a priori with the ultimate goal of energization, not just electrification.

She received the Dorothy Westerman Hermann Endowed Professorship in Science at NKU and is the first from her department to receive it. She has more than 10 technical papers published in various international conferences and journals and won both first place and people’s choice award at OSU's College-level 3 Minute Thesis (3MT) Competition in February 2016. Her areas of interest are smart grids, integration of renewable energy systems, microgrids, energy management and controls, neural networks, deep learning, fuzzy logic and direct energy conversion.

Dr. Maheshwari is passionate about sustainability and green energy. She is also an ardent traveler who has, in the past six years, visited more than 30 states in the US and three European countries. She is a sports enthusiast and follows cricket, tennis, college football and badminton. She also enjoys reading, music and dance.

NILESH DIXIT

Dr. Nilesh Dixit is an exploration geophysicist with seven years of experience in structural geology, basin analysis, rock mechanics and reservoir modeling for the characterization of unconventional and conventional hydrocarbon reservoirs in Alaska. He has published numerous papers on 3D modeling sedimentary basins and unconventional hydrocarbon reservoirs in interior Alaska using integrated geological, geomechanical and geophysical datasets. His research has been funded by major grants and contracts from industry, the Alaska Department of Natural Resources and the U.S. Air Force. He has successfully participated in several large interdisciplinary projects, most recently a study of the environmental, engineering and economic issues related to a proposed coal-to-liquids plant in interior Alaska and a study on the unconventional tight shale reservoirs, funded by the Alaska Department of Natural Resources.

He earned a bachelor’s degree in instrumentation engineering from Pune University in India, and his master’s degree in marine geosciences is from the United Kingdom at the University of Plymouth. He went to the University of Alaska Fairbanks for his PhD in exploration geophysics, where his research implemented various mathematical and computational techniques to perform geological and petroleum assessments in sedimentary basins of Alaska.

At NKU, Dr. Dixit’s goal is to continue his research into improving our understanding of energy resources and develop a high-quality teaching program to provide contemporary geophysics education and training to students committed to geophysics. Looking forward, he also wants his students to be ready for change, in terms of learning disruptive geophysical technologies and computational tools to solve science and engineering problems.
In the spring of 2018, the Geology department introduced a new and exciting opportunity for the NKU students. For the first time ever, the department offered a major field trip opportunity specifically designed for introductory level students.

While the spring semester's GLY 110 featured a lecture similar to other 110 courses, the lab for this unique class was completed during a week-long trip to central Colorado in late May. During the trip, students applied concepts learned from lecture to various scenarios, while also studying regional geology different from what's in the area of NKU.

Twenty students from a variety of academic backgrounds completed the course, and reactions ranged from newfound appreciation for geology and the earth to decisions to join the program as a geology majors.

The class, developed and facilitated by Daniel and Sarah Hunter, was so successful that it will be available again for the spring 2019 semester. With spring registration at hand, the course’s waiting list has already begun to fill, and excitement is once again growing among students and faculty.