

2023

ANNUAL REPORT



IDEA
EPSCoR
NEBRASKA

Established Program to Stimulate Competitive Research



Table of Contents

3	Director's Message	13	Track-2 FEC Awards
4	State Committee	14	Outreach & Education
6	NSF RII Track-1: EQUATE	16	NIH IDeA, NASA EPSCoR, DOE-EPSCoR, DoD-EPSCoR
10	FIRST Awards	18	NSF Co-Funding
12	Small College Awards	19	Cumulative Federal EPSCoR Funding in Nebraska



*Established Program to Stimulate Competitive Research
Institutional Development Award Program*

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You're Invited!

Join Nebraska EPSCoR as we host NSF's biennial EPSCoR meeting in Omaha.



We expect 400+ researchers, staff, and students at Hilton Omaha to advance broadening participation in STEM (science, technology, engineering, and math).

INFO/REGISTRATION:

epscor.nebraska.edu/nsfepscorconf



Nebraska's Established Program to Stimulate Competitive Research (EPSCoR) office is funded by the National Science Foundation via OIA-2044049. Any opinions, findings, and conclusions or recommendations expressed in this material do not necessarily reflect the view of the National Science Foundation.



DIRECTOR'S MESSAGE



AS 2023 DRAWS TO a close, Nebraska's multi-campus education and research venture focused on Emergent Quantum Materials and Technologies (EQUATE) has reached its midpoint. In its first two years, this five-year, \$20 million project funded by the National Science Foundation (NSF) has been a shining example of the impact that NSF's Established Program to

Stimulate Competitive Research (EPSCoR) has on our state.

Led by Dr. Christian Binek with the Department of Physics and Astronomy at the University of Nebraska-Lincoln (UNL), EQUATE's research team of 20 senior investigators has researched new materials that have fast-tracked Nebraska's entry into the "second quantum revolution." Since its inception, the EQUATE team has worked at a blistering pace, resulting in 88 peer-reviewed publications in its first two years. These experimental findings lay the groundwork for a new generation of consumer products, enabled by the novel properties of these unique quantum materials.

Revolutionizing information technology, advanced medical diagnostic tools, and cryptography with impact on security areas such as defense and banking—that's a small sampling of how these new materials will change our lives. Production of

quantum computers that are as accessible as today's cellphones and laptops ultimately will rely on quantum materials. While home installation of these highly-accurate, super-fast machines may still be decades away, the benefits of this Nebraska EPSCoR project can be seen now.

EQUATE has enhanced Nebraska's research infrastructure and capacity by investing in new equipment available to a broad base of users in industry, government labs, and academia. EQUATE funding has also led to the hiring of talented quantum science and engineering researchers, and has increased public awareness of quantum science and technology via education and outreach programs throughout the state.

Yes, we are only at the halfway point, but I continue to be impressed by the accomplishments of the EQUATE team. In the following pages, you can read more about EQUATE and all the other amazing things that Nebraska EPSCoR accomplished in 2023! ■

STATE COMMITTEE

COMINGS & GOINGS



Shane Farritor grew up in Ravenna, Nebraska, and earned his bachelor's degree from the University of Nebraska-Lincoln College of Engineering. His master's and doctorate degrees are from the Massachusetts Institute of Technology. He also studied at the Kennedy Space Center, Goddard Space Flight Center, and the Jet Propulsion

Laboratory. He joined the UNL College of Engineering faculty in 1998. Farritor is co-founder and chief technology officer of the Lincoln-based Virtual Incision, which is working to commercialize miniature surgical robots for minimally invasive procedures. He has a grant from NASA EPSCoR for testing of a surgical robot aboard a space mission, scheduled for 2024. He was the inaugural winner of the University of Nebraska system's Faculty IP Innovation and Commercialization Award and one of the founders of Virtual Incision, Inc.



Bryan Kuntz is president of Intellicom, a Kearney-based IT company. Originally from Colorado, he graduated from the University of Nebraska at Kearney with a degree in Organizational Communications. Kuntz next worked at Curtis and Associates in Kearney, and then worked with Intellicom for the past

20 years. Kuntz prioritizes Intellicom's historically strong internship program with UNK to help keep technology graduates in Nebraska. As an industry representative on the committee, he succeeds Gloria Thesenvitz, chairperson of the board for central Nebraska's Nova-Tech, Inc., who served two consecutive terms on the committee.



Julie Shaffer is the University of Nebraska at Kearney's interim senior vice chancellor for academic affairs. She succeeds Kristen Majocha, who left the position in July 2023. Shaffer joined UNK's Department of Biology in 1999. Shaffer earned bachelor's degrees in Biology and English from the University of Sioux Falls; her doctorate in

biology, with an emphasis in microbial physiology, is from the University of Nebraska-Lincoln. She's a past president of the Nebraska Academy of Sciences and Missouri Valley Branch of the American Society of Microbiology; she also has membership in the American Association for the Advancement of Science, National Science Teaching Association, Association of College and University Biology Educators, Entomological Society of America and National Association of Biology Teachers.



Sherri Jones, interim vice chancellor for research with UNL's Office of Research and Economic Development joins the committee after her predecessor, Robert "Bob" Wilhelm, stepped down from the leadership role and returned to his UNL College of Engineering faculty position. Jones began work as UNL's Dean of the College of Education

and Human Sciences in July 2019. Previously, Jones had served as the chair of UNL's Department of Special Education and Communication Disorders and director of the Barkley Memorial Center for seven years. Her research programs focused on auditory and vestibular physiology. Prior to these roles at UNL, Jones held faculty positions at East Carolina University and the University of Missouri. She earned all three of her degrees from the University of Nebraska-Lincoln.



Phil Kozera, formerly Executive Director of Bio Nebraska and CEO of MatMa Corp. stepped down after serving two consecutive terms on the committee.

RE-APPOINTED



Lyle Middendorf retired in mid-2021 after 49 years at LI-COR Biosciences. As Senior Vice President and Chief Technology Officer,

he was involved in clinical cancer imaging instrumentation and cancer targeting agents. His educational training was in electrical engineering; he earned his bachelor's degree from the University of Nebraska-Lincoln and his Professional Engineer (P.E.) designation soon after. He holds 30+ U.S. patents and multiple foreign patents for utilization both in LI-COR's product lines and out-licensing to numerous companies.

Middendorf served previously on Nebraska's EPSCoR State Committee from 1993-2017 including service as Chair from 2006-2017. In retirement, he lives both in Lincoln and in the Barcelona, Spain area. ■

Key Performance Indicators for Nebraska EPSCoR

NESTIP
Since 2001

191
interns funded

— AT —

103
companies



DID YOU KNOW?

SINCE 2001, NEBRASKA EPSCoR has conducted **Nebraska Engineering, Science and Technology Internship Program (NESTIP)** with **191 individual interns placed at 103 different Nebraska companies**. Participants can be undergraduate or graduate students at Nebraska higher education institutions; a company hosting NESTIP interns must have a Nebraska location where the student will work, but the company is not required to have its headquarters in Nebraska.

In Summer 2023, University of Nebraska-Lincoln rising senior **Kalynn Meyer** was a NESTIP-funded Digital Agronomy intern with **Sentinel Fertigation**, a startup based at Nebraska Innovation Campus (NIC). Meyer's major is Agricultural Engineering (her minor is Agronomy), and she's especially interested in precision agriculture. At Sentinel Fertigation her responsibilities included site monitoring and data collection for multiple commercial scale research projects throughout Nebraska. She compiled datasets, image libraries, and reports for those fields, and presented about these areas during bi-weekly team meetings. She also learned about product support efforts, the software development process, and successful delivery of digital agronomy products to farmers.

Meyer—a three-time winner of the Omaha World-Herald's girls' high-school athlete of the year title during her upbringing in Superior, Nebraska—initially played for Husker Volleyball. She's currently on the UNL Track Team and competes in throwing events. Her internship at NIC was convenient to Husker Athletics' training facilities at the Devaney Center, and UNL's adjacent new track site. GBR! ■

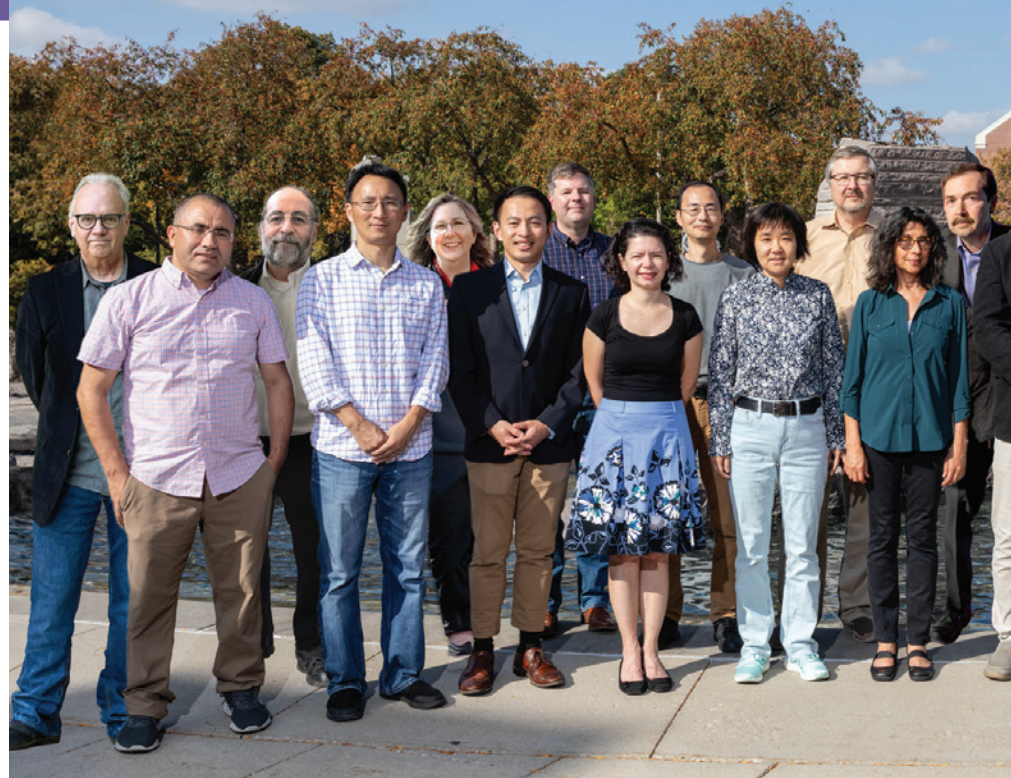
NSF RII TRACK-1: EQUATE

NSF Panel Praises Progress, Publications During EQUATE Reverse Site Visit

YEAR 2 OF THE Emergent Quantum Materials and Technologies (EQUATE) project brought a scheduled Reverse Site Visit via Zoom with a panel convened by the National Science Foundation. The panel praised the number of EQUATE-generated research publications (88 in the project's first two years), as well as the breadth of outreach activities and audiences. The panel noted interest in further growth of the project's Seed Grant program (supporting five researchers to date) and interactions with industry. EQUATE seed grant awardees named in 2023 were **Mohammed Ghashami** (assistant professor with University of Nebraska-Lincoln Department of Mechanical & Materials Engineering) and **Martin Centurion** (professor with the UNL Department of Physics and Astronomy).

A team co-led by EQUATE's scientific director **Christian Binek**, Charles Bessey Professor of physics and director of the Nebraska Center for Materials and Nanoscience, was chosen to receive \$4.17 million in a Catalyst Award from the University of Nebraska-Lincoln's Grand Challenges initiative; the four-year project, with co-leader **Susan Hermiller** (Willa Cather Professor of mathematics), is titled "Quantum Approaches Addressing Global Threats." In March, Binek also participated in an NSF EPSCoR workshop on Quantum Computing, Information Science and Engineering—convened at NSF headquarters in Alexandria, VA.

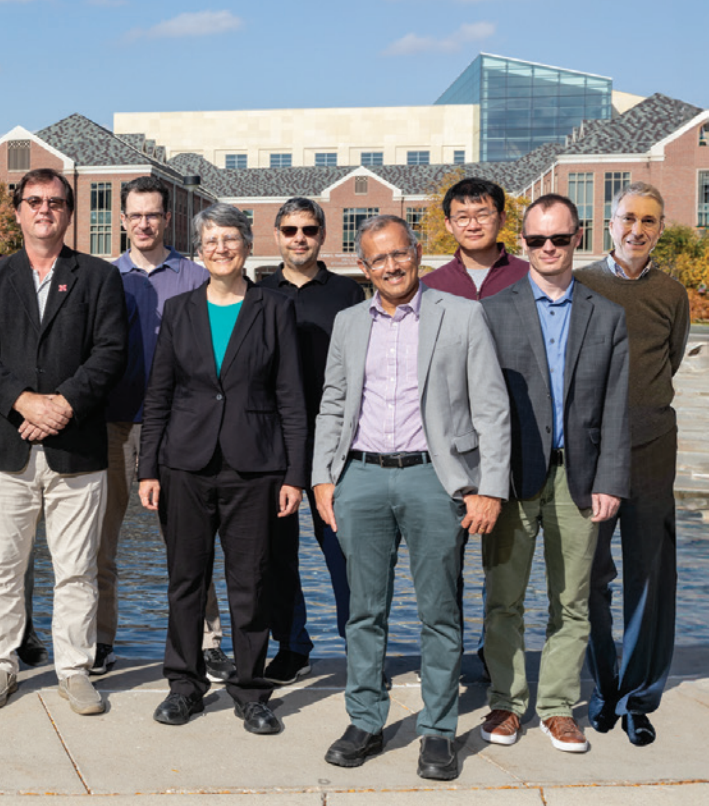
Robert Streubel, assistant professor with UNL's Department of Physics and Astronomy, was recognized by the Royal Society of Chemistry journal *Nanoscale* as one of approximately 100 "rising stars of nanoscience and nanotechnology research." Streubel is part of EQUATE's Focused Research Group (FRG) 1 team; his research on the electronic structure of cobalt valence tautomeric molecules in different environments—a collaboration



with EQUATE colleagues **Peter Dowben**, **Rebecca Lai** and others—was featured in the journal's special edition.

Evgeny Tsymbal (part of EQUATE's FRG1 and George Holmes University Distinguished Professor of Physics at UNL) and an international team have demonstrated how to construct, control, and explain the oxygen-deprived walls of a nanoscopically thin material suited to next-generation electronics. These walls can talk in several electronic dialects that could allow the devices housing them to store even more data, and they can retain their data states even if their devices turn off. The findings were published in a February 2023 edition of the journal *Nature*.

Abdelghani Laraoui, leader of EQUATE's FRG2, led teams that achieved a research publication distinction and a new funding award from NSF. In the August 21 edition of *Advanced Optical Materials*, Laraoui's group earned back cover status for their work on Plasmon Enhanced Quantum Properties of Single Photon Emitters with Hybrid Hexagonal Boron Nitride Silver Nanocube Systems. In addition, his collaboration with Wichita State University researchers **Kapildep Ambal**, a physicist,



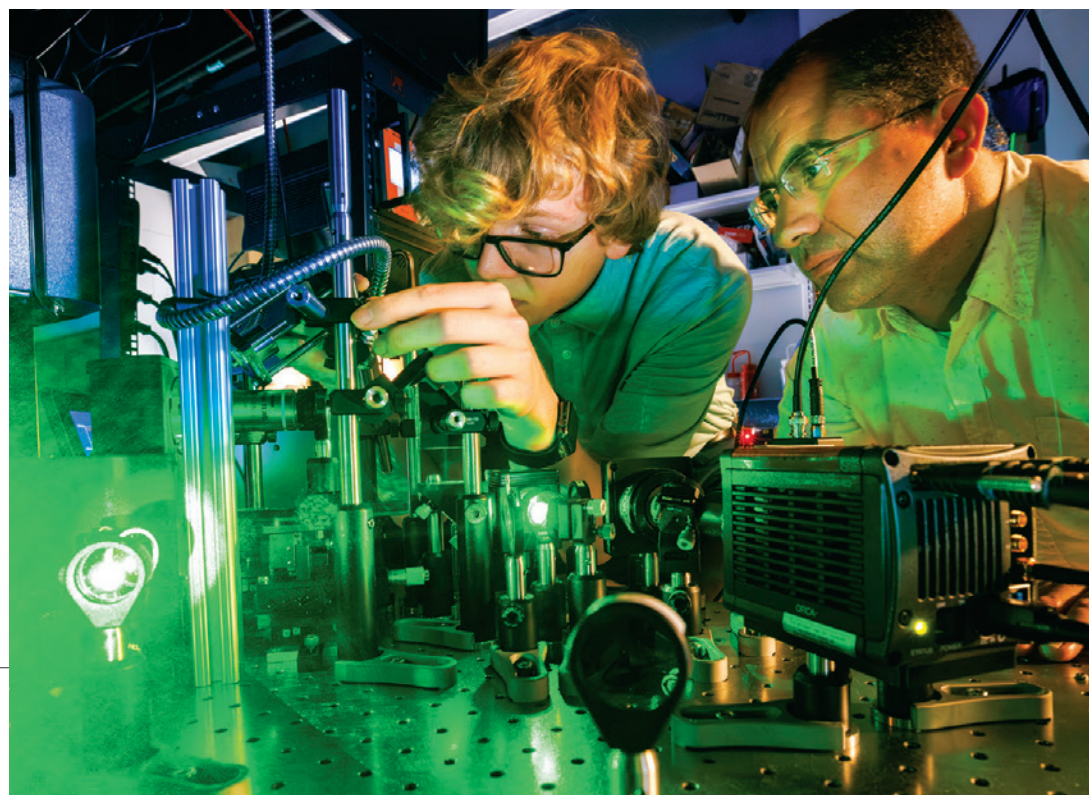
◀ Several EQUATE members are participants in 2023's \$4.17 million Catalyst Award from the University of Nebraska-Lincoln's Grand Challenges Initiative. Their project is titled "Quantum Approaches Addressing Global Threats." Photos by UNL Photography.

and **Jian Wang**, a chemist, gained a three-year, \$800,000-Track 1 award from NSF's Expand Capacity in Quantum Information Science and Engineering (ExpandQISE) program. They seek more robust materials such as ultrathin magnetic films and two-dimensional magnetic materials, and will try to use them to control spin qubits in diamond at longer distances that can work at higher temperatures. Key to this work is a cryogenic scanning probe microscope with quantum sensing, which the Nebraska Center for Materials and Nanoscience procured via other NSF funding.

EQUATE's Year 2 included the departure of **Christos Argyropoulos** (former assistant professor with UNL Electrical & Computer

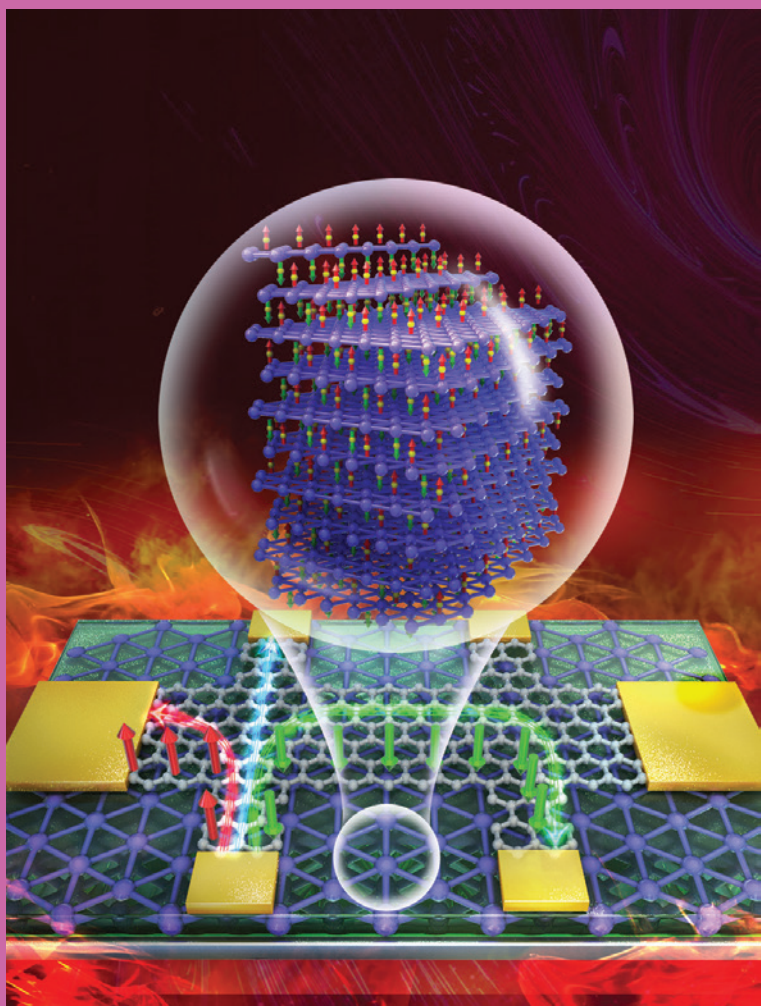
Engineering, and FRG2 investigator), who joined Penn State University's Materials Research Institute as an associate professor. In EQUATE's Year 3, **Wei Bao** (former assistant professor with UNL Electrical & Computer Engineering, and investigator with FRG2 and FRG3 teams) joined the faculty at Rensselaer Polytechnic Institute. EQUATE named successors with the project including **Ufuk Kilic** (for Argyropoulos), and **Alexander Sinitskii** (for Bao); Kilic had been a longterm postdoctoral researcher with FRG2, and Sinitskii joined EQUATE initially as a seed-funded researcher. ■

▼ EQUATE's **Abdelghani Laraoui** (right) works with **Ben Hammons**, a former Young Nebraska Scientists High School Researcher who's now attending UNL and still working in Laraoui's lab.



► *EQUATE Conducts Annual Conference*

THE 2023 NEBRASKA RESEARCH & Innovation Conference in Lincoln focused on Topology and Valley-Driven Quantum Phenomena — a topic important to the Emergent Quantum Materials and Technologies (EQUATE) team. **Xia Hong**, UNL Physics professor, coordinated the slate of speakers including researchers from the University of Washington, Harvard University, and the University of Michigan. Nearly 100 participants, including many student scientists, attended; more than 30 of them presented their research posters during the March 17 event. ■



QUANTUM LEAP

Kearney HS Science Teacher Collaborates With EQUATE Faculty at UNK

THIS SUMMER, KEARNEY HIGH School (KHS) science teacher **Alison Klein** added “RET” to her professional distinctions. The acronym RET does not stand for “retired”—far from it—but refers to “Research Experience for Teachers”: a way to enhance her teaching.

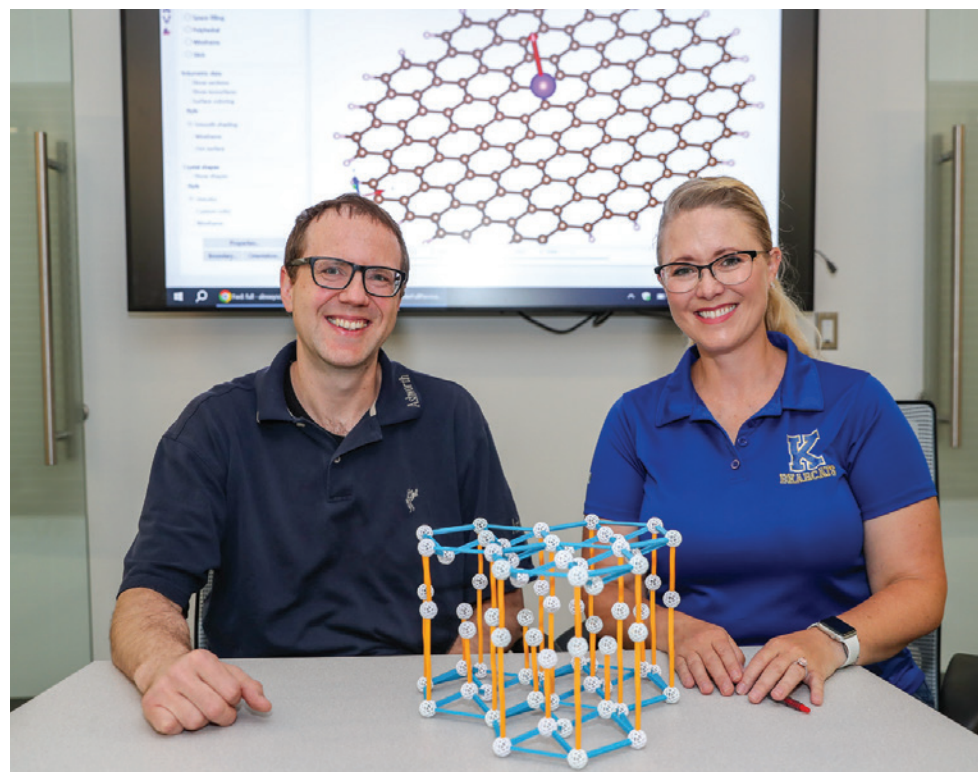
RETs enable teachers to use their summers to delve into science—with payment for their time—by pairing with mentors: typically, university faculty doing research in areas related to the teacher’s interest. Klein, who teaches chemistry at KHS and leads the school’s Science Olympiad team, connected with **Aleksander Wysocki**, assistant professor of physics at the University of Nebraska at Kearney (UNK), who is part of EQUATE. In addition, EQUATE conducts outreach that helps the public to better understand quantum science and inspires new generations of America’s scientists.

Klein said her summer workdays at UNK Physics “flew by.” With Wysocki’s group she used her chemistry background to help develop theoretical models to further “build the body of knowledge” about quantum. Next she’ll engage her students in the research that applies the nation’s Next Generation Science Standards (NGSS) in her KHS teaching—especially by using phenomena, including touch-screen electronics, to show how quantum materials can boost technology that’s familiar to students.

Wysocki said hosting a RET stems from his longstanding motivation to communicate science to improve public understanding of research. His hiring at UNK in 2022 was partially funded by EQUATE. In his first UNK semester he gave a Science Café talk on quantum topics for Sigma Xi, a group that links scientists and the community.

This RET connection helps Wysocki go further: to interact with Klein’s classes and host workshops next summer to bring high school students to quantum research. The workshops will be supported by Nebraska

EPSCoR as part of its Young Nebraska Scientists (YNS) program, using NSF EQUATE funding to provide science learning to students throughout the state. ■



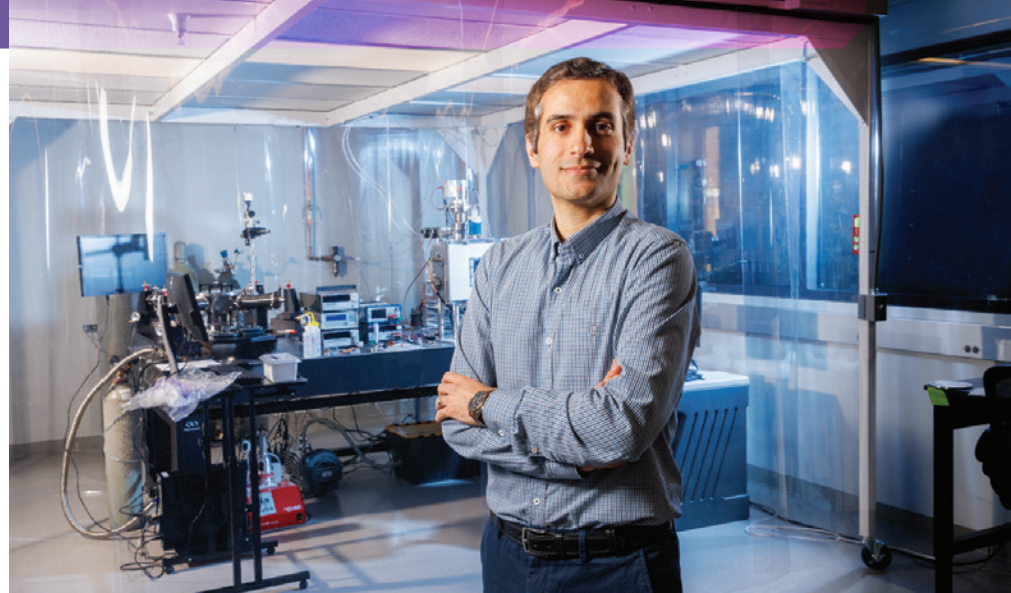
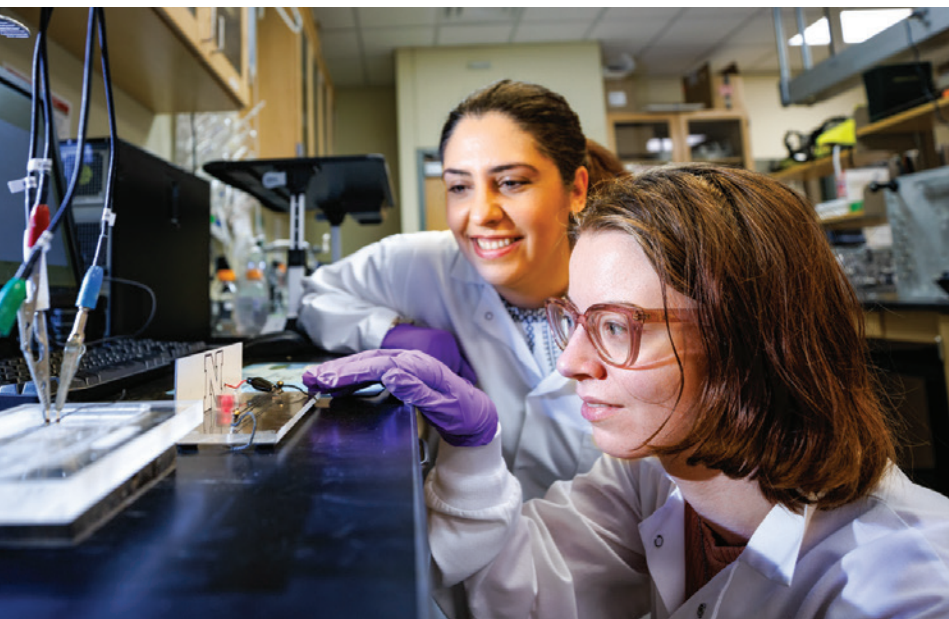
▲ UNK Assistant Professor of Physics **Alex Wysocki** (left) and Kearney High School chemistry teacher **Alison Klein** collaborate on quantum materials in the summer of 2023 via an “RET” (Research Experience for Teachers) funded by the National Science Foundation via Nebraska EPSCoR. Photo by University of Nebraska at Kearney.

FIRST AWARDS

Three FIRST Award Recipients Receive NSF CAREER Awards

UNIVERSITY OF NEBRASKA-LINCOLN'S (UNL) **Mona Bavarian**, assistant professor of chemical and biomolecular engineering, earned a five-year CAREER Award for \$576,802 from the National Science Foundation (NSF). She's researching Continuous Flow Chemistry of Microelectronics Polymers via Combined Physics-based and Machine Learning Models.

Bavarian plans to create a platform for data-driven design of polymer materials and their manufacturing processes, as well as optimal operation and control of these processes. Her approach is to use continuous flow reactors that allow for the precise control of polymer properties and structure; this platform is also eco-friendly, as it promises to reduce the carbon footprint, decrease operating costs, and limit the amount of inferior, unusable materials generated during manufacturing. The program will also benefit other fields, as the modeling and manufacturing knowledge her lab team gains should apply to other specialty polymers. In addition to training graduate and undergraduate students in research, the work will augment course materials on advanced manufacturing and outreach activities via high school teacher trainings focused on advanced manufacturing and microelectronics.



Mohamed Ghashami, assistant professor with UNL Mechanical & Materials Engineering, received a five-year, \$629,702 NSF CAREER Award for research on Understanding Nanoscale Radiative Transport in Multi-Body Systems.

His team aims to experimentally uncover the governing physics that drive electromagnetic wave-matter interactions in multi-body systems, to identify the contributing factors in near-field radiative heat transfer (NFRHT). Their study of nanoscale radiative heat transfer between multiple objects will focus on improving heat exchange and thermal control.

This work will provide new knowledge critical to the development of next-generation nanodevices by: (1) understanding the effect of structural factors on NFRHT in multi-bodies and (2) elucidating the role of multi-body physics in NFRHT for active thermal management.

In addition to advancing thermal control at the nanoscale, the project's educational component promotes practical workforce development: bridging the gap between academia and industry, while stimulating curiosity among K-12 students about engineering careers. This project's education objectives include creating an Academic-Industry Bridge (AIB) initiative for undergraduate and graduate students and extending the AIB with an interactive platform for hands-on research projects among K-12 students. Collaborations with Navajo Technical University and the University of Texas Rio Grande Valley will ensure engagement with diverse audiences.



Keegan Moore, assistant professor with UNL Mechanical & Materials Engineering, has gained NSF's CAREER Award for Modeling the Loosening of Bolted Joints due to Nonlinear Dynamics of Structural Assemblies. Moore's \$727,410 research project investigates how loss of integrity of bolted joints leads to failure of safety- and reliability-critical mechanical structures—applying to

vehicles, industrial equipment, biomedical implants, space telescopes, and playground equipment.

Loose bolts and screws are a common problem in US infrastructure. Structural failures often have catastrophic consequences, for example, resulting in vehicle crashes or train derailments that lead to casualties, economic loss, and environmental damage. Little is known about how a structure's dynamics influence the loosening of bolted joints over long periods of operation. Moore's approach studies structural dynamics and the integrity of bolted joints over timespans consistent with the structure's service life, leading to improved health monitoring of aging infrastructure, toughened designs against the impacts of extreme weather, and more reliable energy generation from renewable sources.

The project's educational platform advances STEM learning and enhances diversity through a Teach for Discovery approach, engaging students' natural curiosity through game-based learning and virtual reality experiences. ■

2023 FIRST Award Recipients



STEVEN FERNANDES, Creighton University –
Computer Science, Design and Journalism

KWANGSUNG OH, University of Nebraska at
Omaha – Computer Science

LOCHANA PALAYANGODA, University of Nebraska
at Omaha – Department of Mathematics

ARMAN ROOHI, University of Nebraska-Lincoln
– School of Computing

SHIBIAO WAN, University of Nebraska Medical
Center – Genetics, Cell Biology & Anatomy

JIEQIONG WANG, University of Nebraska Medical
Center – Department of Neurological Sciences

Funded by National Science Foundation's (NSF) infrastructure grants to Nebraska EPSCoR, the competitive FIRST Award grant program aids Nebraska's early-career, tenure-track faculty. The grants help early career faculty initiate their research programs and compete more effectively for NSF CAREER grants. Any project that could be supported by a National Science Foundation competitive research grant is eligible. Each FIRST Award is \$25,000 and requires a match. Photos by UNL Photography

EPSCOR FUNDS 2023 NEBRASKA SMALL COLLEGE/UNIVERSITY UNDERGRADUATE RESEARCH EXPERIENCES

TO INCREASE UNDERGRADUATE RESEARCH opportunities at Nebraska's smaller colleges and universities, Nebraska EPSCoR offers funding up to \$5,000 per project for collaborations in science, technology, engineering and math (STEM) areas. Faculty and students involved in the proposals selected (below) report their project results to Nebraska EPSCoR and present their research in scientific publications and at conferences. Recipients for 2023 are:

Dr. Kazuma Akehi, University of Nebraska at Kearney, Dept. of Kinesiology and Sport Sciences | *Utility of integrated three-dimensional motion analysis and rapid muscle strength characteristics to identify return-to-play readiness after knee arthroscopic surgery*

Dr. Jared Daily, Mid-Plains Community College, Dept. of Math and Sciences | *Low-Cost Universal, Wireless, and Automatic Datalogger Using an Arduino Microcontroller*

Dr. Keith Geluso, University of Nebraska at Kearney, Dept. of Biology | *Bats of the Northern Gila National Forest, New Mexico*

Dr. Philip Lai, University of Nebraska at Kearney, Dept. of Communication Disorders | *Coding of Parental Communicative Behaviors in Young Children with Autism Spectrum Disorder*

Dr. Jason Price, Wayne State College, Dept. of Physical Sciences & Mathematics | *Redox-driven iron diffusion controlling vivianite formation in lake-bottom sediments of Rocky Mountain National Park*

Dr. Jane Roitsch, University of Nebraska at Kearney, Dept. of Communication Disorders | *Dysphagia Assessment and Treatment in pediatric patients: A study of practice patterns*

Dr. Ladan Ghazi Saidi, University of Nebraska at Kearney, Dept. of Communication Disorders | *NeuroCognitive Effects of Learning a New Language: An fMRI study* ■

SMALL COLLEGE TEACHING/RESEARCH EQUIPMENT FUNDED

NEBRASKA EPSCOR'S "TRE" AWARDS provide funds for Teaching and/or Research Equipment at the state's small public or private colleges (with annual research expenditures of less than \$8 million). This TRE program emphasizes new, shared-use equipment and instrumentation that will enhance research and/or education activities for STEM (science, technology, engineering, and math) learning. Requests for TRE proposals (RFPs) are issued annually, with a limit of one request per institution. Each equipment request must not exceed \$50,000 total. The award pays 80% of the equipment's cost, with 20% coming from the requesting institution. TRE awards are supported by NSF EPSCoR resources, and the Nebraska EPSCoR State Committee decides the TRE proposals selected for funding. The following awards were determined at the committee's meeting on November 7, 2023:

Bellevue University: Kinesiology Lab Equipment

Midland University: Chemistry Equipment

Southeast Community College: Fermentation and DNA Sequencing to Engage Students and Meet Local Workforce Demand

Union College: Gas Chromatograph Replacement for Teaching and Research

York College: Biology Laboratory Trinocular Fluorescent Microscope and Microscope Camera ■



Funding is provided through National Science Foundation award, OIA#2044049. Watch for funding opportunities at Nebraska EPSCoR's Request for Proposals < webpage. For information about these programs, see <https://epscor.nebraska.edu/programs/small-colleges>.

TRACK-2 FEC

Nebraska Part of Two New Multi-State Collaborations Funded by NSF, with Focus on Rural Resilience

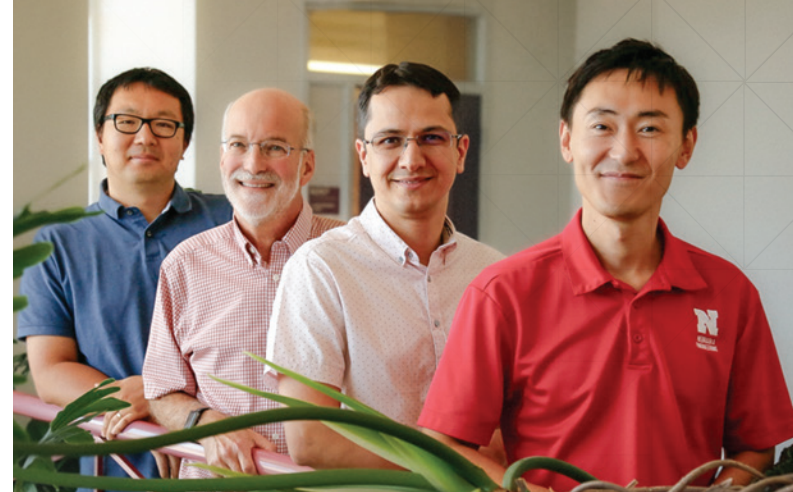
THE 2023 SLATE OF NSF EPSCoR Track-2 FEC (Focused EPSCoR Collaborations) awards focused on a theme of building rural resilience, and Nebraska teams are part of two funded projects.

Rural confluence project studies climate change and social impacts, tests solutions

A COLLABORATION BETWEEN OKLAHOMA State University, Louisiana State University, and UNL's Rural Prosperity Nebraska initiative will bring \$1,119,211 in NSF funding to advance rural climate resilience research and improvements in rural STEM opportunities. The project aims to reach thousands of people and yield economic impacts in rural communities by identifying potential solutions to expected climate change-driven losses.

Mary Emery, director of Rural Prosperity Nebraska at UNL, co-leads the Rural Confluence project—which focuses on diverse but connected communities, disciplines, and institutions within the Mississippi River basin. Partners also include Hispanic and Native American minority-serving institutions: Western Oklahoma State College and Northern Oklahoma College.

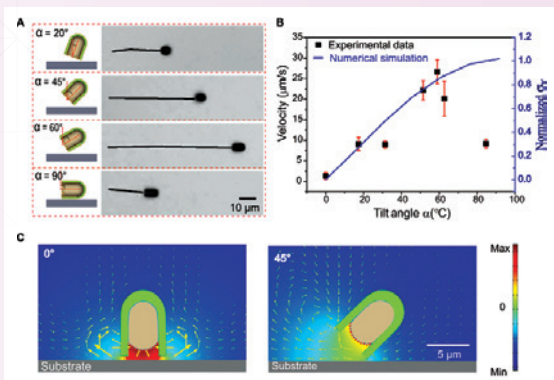
The Rural Confluence project will develop community resilience action plans to be tested in six focus communities. Simulations will incorporate state-of-the-art climate projections into a suite of interconnected open-source models to estimate hazard exposure, damages, and long-term community recovery or decline—with and without locally-prioritized adaptation measures. Simulation results will be shared with the communities, contributing to the development of local resilience action plans.



Multi-state MICRA team researches plains agriculture amid drought, studies social science impacts

MICRA, OR MICROBIAL INNOVATIONS for Climate-Resilient Agriculture, team includes the University of Nebraska-Lincoln (UNL), Kansas State University (KSU), and Oklahoma's Langston University (LU). The Nebraska group is led by **Seunghee Kim**, UNL associate professor of civil engineering, and includes co-leaders **Daniel Schachtmann** (George Holmes Professor of agronomy and horticulture) and **Rajib Saha** (Richard L. and Carol S. McNeel Associate Professor of chemical and biomolecular engineering). This four-year, \$6 million project includes \$2.1 million in funding for Nebraska, to support a team of 30+ faculty and students.

According to the MICRA proposal, supporting rural communities is crucial in the Central High Plains region, where agriculture's direct impact measures in billions of dollars. This region faces increased frequency and severity of drought due to climate change; in 2022, nearly all areas of the states of Nebraska, Kansas, and Oklahoma experienced drought conditions. The MICRA project gathers interdisciplinary expertise from engineering, science, agricultural science, and social science—to conduct research with the goal to preserve soil moisture and improve water quality under drought conditions. ■



TRACK-4

NAMA GAINS NSF AWARD TO RESEARCH ACOUSTIC, MAGNETIC MOVEMENT OF MICROSWIMMER DEVICES

NITESH NAMA, ASSISTANT PROFESSOR with University of Nebraska-Lincoln (UNL) Mechanical & Materials Engineering, gained an NSF EPSCoR Track-4 award to study microscale synthetic devices, or microswimmers, approximately 10 microns in length (note: a micron is one millionth of a meter) that could transform healthcare and bioengineering. His research aims to integrate acoustic and magnetic fields to achieve controlled motion at microscales.

“Microswimmer devices can provide direct access to complex regions of the human body through on-board imaging and wireless data transmission to enable targeted drug delivery and localized medical interventions,” Nama said. He added that microscale propulsion research has progressed, but further work is needed for controlled, programmable, and biocompatible motion of microswimmers.

With this award’s three years of funding—totaling \$185,120—Nama and a UNL graduate student researcher will integrate computational methods with experimental measurements, using state-of-the-art fabrication and characterization facilities at the University of Pennsylvania, in collaboration with Prof. **Thomas Mallouk**.

Nama’s approach focuses on numerical characterization of interactions between acoustic frequency, bubble oscillation modes, and the flow field around the microswimmer; his team relates microswimmer trajectories with the external acoustic and magnetic fields to identify novel microswimmer designs and functions via their integrated computational and experimental approach. He also plans to establish a long-term collaboration between UNL and Penn, to further explore fundamental mechanisms that govern microswimmer motion. ■

OUTREACH



What’s new?



young
nebraska
scientists

NEW YNS CAMPS...

TWO NEW CAMPS FOR middle and high school students added to Young Nebraska Scientists’ (YNS) summer learning experiences—Food Science: Exploring Dairy Products, the Milky Way; and Pizza, the Rise of the Dough. The camps were shaped by a UNL Food Science and Technology (FST) team, including graduate students led by Associate Professor **Andreia Bianchini Huebner**; Department Chair **Curt Weller** committed scholarships to campers who apply to the FST undergraduate program after high school.

...NEW MOBILE LABS...

THANKS TO NEBRASKA EPSCoR’S NSF-funded EQUATE project (see page #6 in this publication), YNS added Elemental Analysis, Planck’s Constant, and Spectral Analysis to the sets of equipment, supplies, and curriculum that Nebraska teachers can request—with free shipping to their schools.

...NEW AND RETURNING RESEARCHERS!

THE SUMMER OF 2023 was the largest cohort of YNS High School Researchers, with 18 participants funded by EQUATE and industry partner J.A. Woollam Co. of Lincoln: maker of globally-used ellipsometry equipment and founded by Professor **John Woollam** with UNL College of Engineering. ■



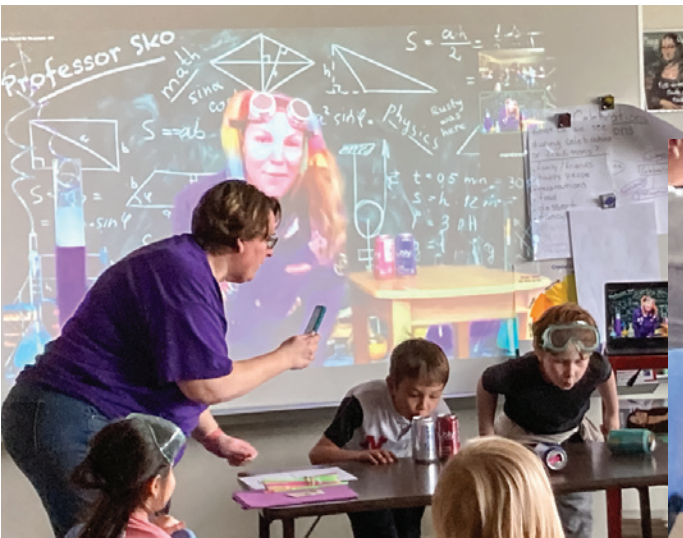
BRING YOUR DOG (DNA) TO SCHOOL

A NEW “CITIZEN SCIENCE” partnership, partially-funded by Nebraska EPSCoR, focuses on the genetics of our four-legged friends, to interest local students in Nebraska’s biotechnology jobs.

The 2022-25 project aims to “directly connect biotechnology to students’ lives.” **Misty Wehling**, Southeast Community College’s Biotechnology Program co-chair, said participating students collect cheek-swab DNA samples from pets to study how a dog’s genes affect its social behavior. The activities also increase scientific literacy and engagement with science and technology for high school and college students and their teachers.

Nebraska high school biology and agriculture teachers joined SCC-led workshops in laboratory techniques to implement the course-based research. In June, they gathered at industry partner Neogen, where training and supplies kits were provided. Nebraska EPSCoR is adding the unit to its mobile lab kits shipped to classrooms across the state, to further sustain the genetics learning.

This project offers “a model for supporting high school teachers, including those in resource-limited areas, (to) incorporate new engaging curricula,” said Wehling, the grant’s principal investigator. “It also models partnership with industry ... to increase awareness, knowledge, and skills related to biotechnology careers important to developing our state’s competitive STEM (science, technology, engineering and math) workforce.” ■



LEARN MORE ABOUT PROFESSOR SKO:



professorsko.com



PROFESSOR SKO MAKES STEM FRIENDS

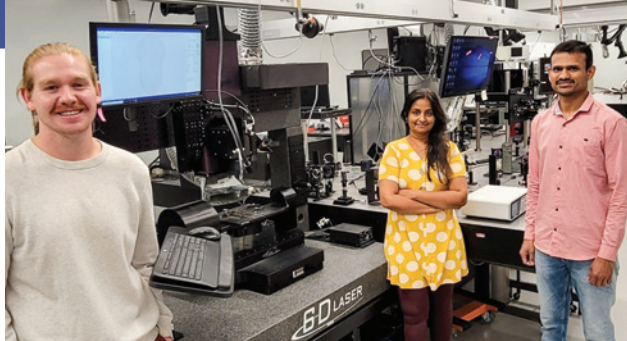
IN APRIL, THE AFTERSCHOOL “Little Scientists” club at Lincoln’s Norwood Park Elementary School had an online visit from one of their heroes.

Professor Sko (a persona developed by community college physics professor **Brenda Skoczelas**) creates hands-on science lesson videos and stage shows to excite young people about STEM (science, technology, engineering, and math).

Wearing a purple lab coat with science-themed patches and rainbow coils in her hair, Sko smilingly explained how Bernoulli’s Principle shapes the way birds and aircraft fly. Her friendly face filled the classroom’s big screen, where a dozen students greeted her like a celebrity. The club’s mentor, a Lincoln Public Schools’ Community Learning Centers (CLC) employee, had shown the group Professor Sko videos and led related activities in prior weeks.

During the pandemic, Professor Sko began sharing science to engage young people online. Her YouTube channel has more than 50 videos on science, with interviews of scientists and discussions of activities such as sports (focusing on the science involved)—free for viewers. ■

Nebraska Collaboration Serves NASA Fuel Storage and Transfer in Space



TO SUPPORT SPACE EXPLORATION, NASA relies on cryogenic propulsion systems and associated low-temperature technologies—think: storing, transferring, and controlling the pressure of cryogenic fluids. Collectively, these technologies are referred to as Cryogenic Fluid Management (CFM).

An interdisciplinary team—including University of Nebraska-Lincoln (UNL) engineering faculty **Craig Zuhlke**, **George Gogos**, **Jeff Shield**, and **Siamak Nejati**, and University of Nebraska at Kearney chemistry professors **Scott Darveau** and **Christopher Exstrom**—earned \$750,000 in funding through 2025 via NASA Nebraska EPSCoR for Femtosecond Laser Functionalized Surfaces for Cryogenic Fluid Management. They are developing femtosecond laser surface processing (FLSP) techniques to functionalize, or improve, surfaces for use in CFM.

Propellant management devices, specifically liquid acquisition devices (LADs), are critical to the function of fuel and storage tanks in microgravity. LADs are structures within the tanks that direct fluid to the output. In microgravity, surface tension is the most significant driver of fluid behavior, as opposed to the gravity field on a planet. Therefore, in microgravity, the wetting property of a surface—that is, the ability of a liquid to maintain contact with a solid surface—becomes an important factor in controlling the location and flow of fluids in fuel and storage tanks. LADs can be improved by altering the wetting properties of the LAD surfaces to attract fluids (supercryophilic) and by ensuring that surfaces in other parts of the tank repel fluids (cryophobic).

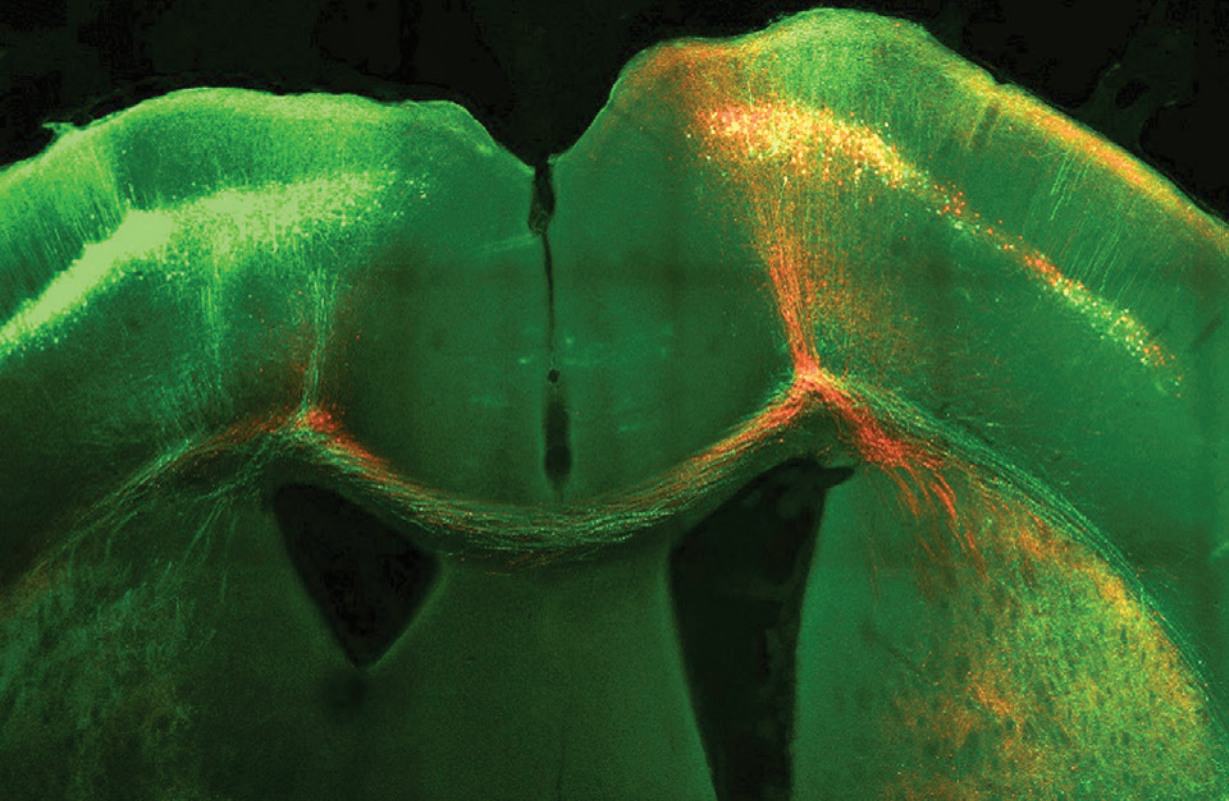
UNL's Center for Electro-optics and Functionalized Surfaces (CEFS), co-directed by Zuhlke and Gogos, has developed techniques to directly functionalize or tailor the surface properties of metals using a FLSP system to modify the wetting properties of surfaces with respect to cryogenic fluids. With FLSP, the properties of surfaces are altered by creating self-organized micro- and nano-scale surface structures combined with laser-induced chemistry changes using finely controlled ultra-short light-matter interactions. The goal of this project is to develop FLSP techniques to alter the wetting properties of fuel tank materials with respect to cryogenic propellant fluids that are stored in the tanks. ■

CoNDA Center Augments Nebraska's Clinical and Preclinical Cognitive Neuroscience Research

AS HUMANS AGE, **SCIENTIFIC** research on the brain becomes increasingly valuable. The Cognitive Neuroscience of Development & Aging (CoNDA) Center is an NIH Center of Biomedical Research Excellence (COBRE) in Omaha, Nebraska, focusing on human and translational neuroscience research across the lifespan. **Anna Dunaevsky** is the project's principal investigator (PI).

Awarded in March 2020, the CoNDA Center has brought \$11,532,966 in research funding to Nebraska (according to NIH, as of 2023)—shared by the partner institutions: University of Nebraska Medical Center (UNMC), Boys Town National Research Hospital (BTNRH), the University of Nebraska at Omaha (UNO), and Creighton University (CU).

The CoNDA Center aims to advance translational and human neuroscience across the region and the world, and enhance the ability of current and future



◀ A brain scan is conveyed via the CoNDA Center's Magnetic Resonance Imaging (MRI) Core.

generations of local scientists to successfully compete for extramural funding, publish high-impact work, and rise to the forefront of the field. To achieve these goals, the center supports research projects, pilot projects, seminars, career development series, and skills workshops.

CoNDA's Administrative Core is housed at UNMC—less than two miles from each of the partner institutions—and is engaged in administration, training, mentoring and evaluation. The Administrative Core promotes the primary COBRE research projects by a promising group of NIH-defined early-stage investigators.

The CoNDA Center supports two research cores geared towards support for COBRE

research projects studying neurocognition in health and disease in human subjects and in preclinical animal models.

The CoNDA Center engages institutional support, including financial support for the center's programs, major equipment expenses, and Core staffing. In addition to CoNDA's established group of PIs in neuroimaging, brain dynamics, development and aging, the center fosters a strong cohort of emerging junior investigators using innovative cognitive and affective neuroscience methods to address major questions in human neuroscience across the lifespan—and accelerating the development of Nebraska's next generation in neuroscience and neuroimaging leadership. ■

CONDA RESEARCH PROJECTS

- The Role of Hippocampal Neurogenesis in the Development of Cognitive Deficits in Autoimmune Encephalitis with Seizures
- The Role of Host Amino Acid Metabolism in Behavioral Changes during Latent Toxoplasmosis
- Hypothalamic Sleep-Wake Neuron Defects in Alzheimer's Disease

CONDA PILOT PROJECTS

- Bioelectrical Brain Markers for Early Diagnosis of Neurodegeneration in Temporal and Frontal areas in patients with FTD, LDB and AD: EEG/MEG study
- Neuroinflammation in Neurodegeneration and Cognitive Impairment associated with Global Ischemia
- CEST MRI for Neuropathology of ART and Nicotine
- Neural Basis of Cognitive Impairments in Older Adults with Myeloid Malignancies

DoD

AMONG 115 SUBMITTALS NATIONWIDE, two teams from the UNL Department of Mechanical & Materials Engineering each earned research awards of more than \$600,000 from the US Department of Defense EPSCoR for three-year projects to aid US national defense:

BAI CUI, Nanoscale Energy Coupling and Material Behaviors in Selective Laser Sintering of Ultra-High Temperature Ceramics

PIYUSH GROVER, Foundations of Defect Engineering for Dynamic Manipulation of Nonlinear Large-amplitude Waves in Metamaterials ■

DOE

IN JULY, THE U.S. Department of Energy (DOE) announced \$33 million to support 14 clean-energy research projects as part of its EPSCoR program—to ensure DOE research funding reaches parts of the nation that traditionally have received disproportionately low amounts of federal scientific funding. Congratulations to these scientists, who are also researchers on Nebraska EPSCoR's EQUATE project:

MARTIN CENTURION, University of Nebraska-Lincoln; Probing Nuclear and Electronic Dynamics in Ultrafast Ring Conversion Molecular Reactions

RENAT SABIRIANOV, University of Nebraska at Omaha; A High-Throughput Computational and Experimental Approach to the Design of Unconventional Magnets ■

2023 NSF EPSCoR Co-Funding for Nebraska

NATIONAL SCIENCE FOUNDATION (NSF) EPSCoR co-funds specific NSF units in support of meritorious proposals from individual investigators and teams in EPSCoR jurisdictions. These proposals have been peer-reviewed and recommended for award, but could not be funded without the combined, leveraged support of NSF EPSCoR and the corresponding directorates. Co-funding leverages EPSCoR investment and facilitates participation of EPSCoR scientists and engineers in NSF-wide programs and initiatives.

In 2023, NSF EPSCoR Co-Funded projects brought \$6,364,447 to Nebraska. Recipients were:

SASITHARAN BALASUBRAMANIAM, University of Nebraska-Lincoln (UNL) School of Computing | Bacterial-based Biosensor Digital Twin for Microbial Community Sensing (US-Ireland-R&D Partnership).

YU-CHE CHEN, CHUNHUA TSAI, EDOUARDO ZENDEJAS, University of Nebraska at Omaha (UNO) School of Public Administration | DASS: A Multi-level Collaborative Design Framework for Cross-sovereignty Software Accountability.

JONGWAN EUN, UNL Dept. of Civil & Environmental Engineering | CAREER: Multi-physical and Multi-scale Testing and Modeling of Water Infiltration through Frozen Soils.

MOHAMMAD GHASHAMI, UNL Dept. of Mechanical & Materials Engineering | CAREER: Understanding Nanoscale Radiative Transport in Multi-Body Systems.

NIRNIMESH GHOSE, UNL School of Computing | Collaborative Research: SaTC: CORE: Small: Towards Robust, Scalable, and Resilient Radio Fingerprinting.

ELOÍSA GRIFO, UNL Dept. of Mathematics | CAREER: Problems in Commutative and Homological algebra.

DAVID HAGE, EDWARD HARRIS, CHIN LI CHEUNG, WEI NIU, ANGELA PANNIER, UNL Dept. of Chemistry | MRI: Track 1 Acquisition of a SEC/FFF-MALS-DLS.

ALLISON JOHNSON, DAIZABURO SHIZUKA, UNL School of Biological Sciences | Resolving the drivers of variation in cooperative social groups along environmental gradients.

KRISTI MONTTOOTH, COLIN MEIKLEJOHN, University of Nebraska-Lincoln School of Biological Sciences | Collaborative Research: EDGE CMT: Mechanistic basis of cricket wing dimorphism: predicting phenotype from genotype in complex threshold traits.

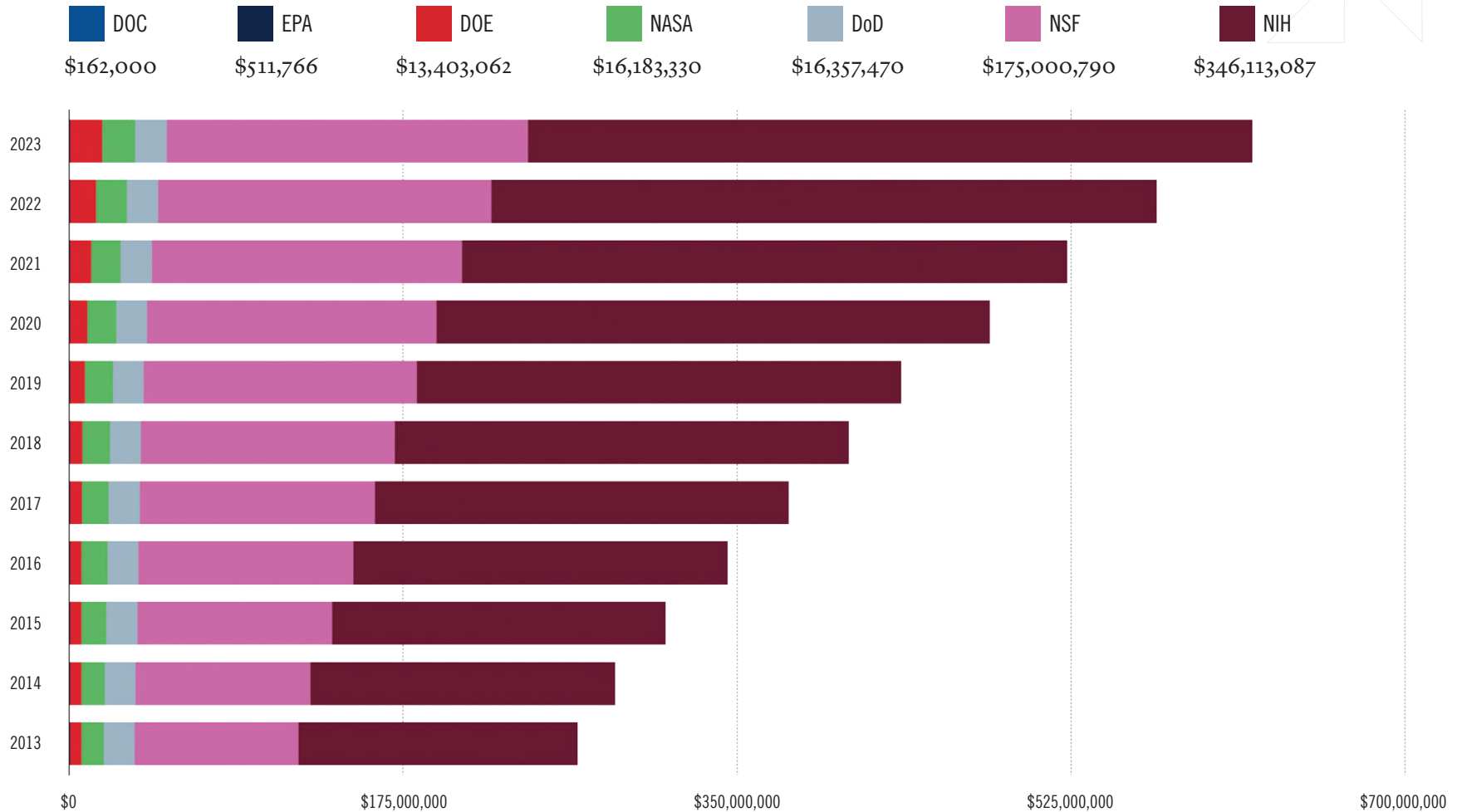
KURT PIEPENBRINK, University of Nebraska-Lincoln Dept. of Biochemistry | Structural Mechanisms of Bacterial Extracellular DNA-recognition.

JOSEPH TURNER, University of Nebraska-Lincoln Dept. of Mechanical & Materials Engineering | Collaborative Research: Cellular and Biomechanical Mechanisms of Rapid Stomatal Dynamics in Grasses.

REGINA WERUM, University of Nebraska-Lincoln Dept. of Sociology | Collaborative Research: Military Service as a Gendered Pathway into STEM. ■

Cumulative Federal EPSCoR/IDeA Funding in Nebraska

NEBRASKA BECAME AN EPSCoR state in 1991 and has successfully competed for more than \$620 million in federal EPSCoR or EPSCoR-like research funding. This chart shows funding by agency and the cumulative growth of funding over time for the most recent decade: 2013 – 2023. ■



Nebraska EPSCoR

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Looking ahead to fall 2024



2023 State EPSCoR/IDeA Committee Members



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Dr. Sherri Jones, *Interim Vice Chancellor for Research & Economic Development*, University of Nebraska-Lincoln

Mr. Phil Kozera, *former CEO*, MatMaCorp

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