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Enterprise

2022 THE UNIVERSITY OF MARYLAND RESEARCH MAGAZINE

Mapping the Quantum Frontier

UMD EXPANDS ITS FOOTPRINT AS THE "CAPITAL OF QUANTUM" WITH LATEST LAB AND INSTITUTE TO ADVANCE MIND-BENDING COMPUTING. 22

From the

Vice President for Research

WHEN I WAS NAMED vice president for research at the University of Maryland earlier this year, I understood that one of my primary roles would be to champion the outstanding scholarship and discovery happening across campus and to shine a spotlight on bold and innovative faculty and students dedicated to improving our state, nation and world.

I'm proud to say this inaugural issue of *Enterprise* makes that part of my job easier. It includes some of our most exciting and impactful research and funding news from the past year, demonstrating how we are reaching across disciplines to take on the grand challenges of our time: using virtual reality to improve police-community relations; developing new approaches to study airborne viruses; creating a method to turn a harmful greenhouse gas into valuable chemicals without releasing pollutants, and much more. No problem is too daunting or complex for researchers at the University of Maryland.

You'll also find two feature stories: a profile of public health researcher Sacoby Wilson, whose life experiences drove his dedication to operationalizing science to help low-income people and communities of color fight polluters for safer, cleaner neighborhoods; and an intriguing overview of UMD's leadership in the global drive to create the new world of quantum computing.

I come to the VPR's office after serving as dean of UMD's College of Behavioral and Social Sciences for over seven years, and I was a faculty member at the Johns Hopkins University's Department of Psychological and Brain Sciences for the previous 23 years. I am and always have been a researcher first, and understand the transformative power of discovering new knowledge and using it to create a lasting impact on society. I am humbled to now lead a research enterprise that can stand shoulder to shoulder with any other in the world.

I hope you will enjoy learning more about the University of Maryland's vast and vibrant community of scientists, scholars and engineers, and be as inspired as I am by their work moving us fearlessly forward.

Go Terps!

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COVER
Photo by John T. Consoli

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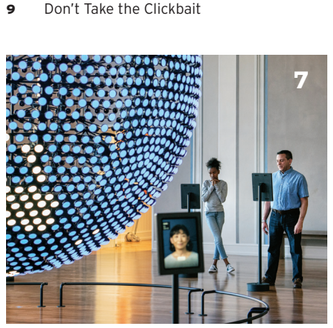

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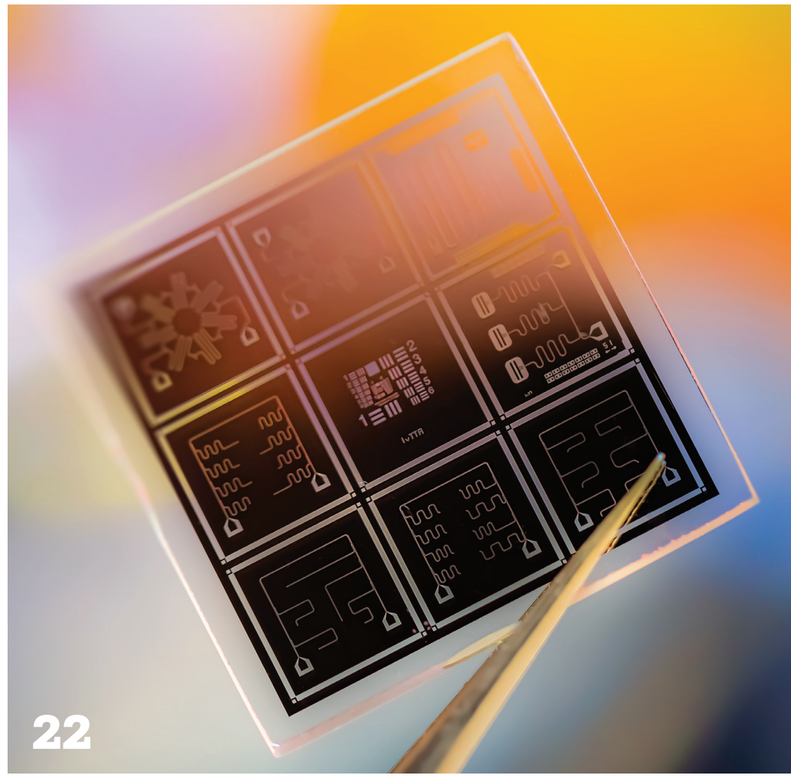

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UMD expands its footprint as the "capital of quantum" with the latest lab and institute to advance mind-bending computing.

Learn more about the University of Maryland's diverse, dynamic research enterprise at ***research.umd.edu***.

VR Training Aims to Improve Police-Public Interactions

Google Unit Draws on Researcher's Expertise on Systemic Racism, Bias

THE UNIVERSITY OF MARYLAND and Jigsaw, a unit of Google, are creating groundbreaking virtual reality training for police officers to learn and evaluate de-escalation and communication skills.

The ongoing development of Jigsaw's "Trainer" platform incorporates research and input from four higher education institutions, including UMD's Lab for Applied Social Science Research. The lab is led by sociology Professor Rashawn Ray (right), an expert on systemic bias and racism in policing.

"This program is going to completely revolutionize police training, to put officers in a safe environment where they can aim to get better and more objective," Ray says.

Interactions between police and the general public and the disproportionately fatal consequences suffered by Black Americans have become major flashpoints following the deaths of George Floyd in Minneapolis and other unarmed people.

Jigsaw, which develops technology to bolster free and open societies, created Trainer in consultation with experts from academia, law enforcement and civil rights groups. Trainees use virtual reality headsets and controllers to simulate common policing activities like removing potential weapons from tense environments and conducting interviews. Supervisors track performance; for example, a user in a live demonstration streamed by Jigsaw was dinged for failing to adequately identify himself before questioning a party in a domestic dispute.

"We wanted to demonstrate how technology could be a possible solution to the ongoing conversation of public safety," says Sameer Syed, Jigsaw's partnerships and business development lead. "You can merge technological innovation with cultural dimensions as well as impact for civil rights and social justice."

In addition to UMD, researchers from Morehouse College, the University of Cincinnati and Georgetown Law will collaborate to measure the system's efficacy, identify use cases and integrate it into policing research. Ray, also a Brookings Institution senior fellow, says UMD experts will work to further integrate physiological measurements of heart rate, eye movement or even cortisol levels to understand how a police officer is reacting.

The work on Trainer—like his project with AT&T on anti-bullying and another report with Brookings colleagues on countering racism on social media—demonstrates how research impacts society, he says.

"It's important as professors and scholars to think innovatively, to bring together social science and computer science, industry, the think tank world," he says. "Research can really be used for good. It's not simply about doing research for research's sake."**—LF**

PHOTO BY STEPHANIE S. CORDLE

Study: Ripple Effects of Racism Close Door on Homeownership

ANOTHER STUDY led by sociologist Rashawn Ray illustrates how factors like the legacy of neighborhood segregation and real estate appraisal discrimination still lock Black Americans out of the most important way to build family wealth: homeownership.

He worked with Andrew M. Perry, a lecturer at Maryland's School of Public Policy and senior fellow in Brookings' Metropolitan Policy Program, as well as several of their Brookings colleagues, to lay out a policy path to close the gap between the 46.4% of Black Americans who own homes and the 75.8% of white families that do.

"Even when people (are financially stable), they are still put behind the eight ball because there are systemic racial inequalities baked into the financial pipeline process," Ray says.

The September 2021 study put forward six recommendations, focusing on the financial sector:

- Increase "small dollar" mortgage loan programs;
- Support rate-and-term refinancing options to reduce monthly payments;
- Extend credit and down payment assistance to borrowers impacted by historic discriminatory practices;
- Include rent and utilities in credit scoring instead of prioritizing loan payments;
- Improve the diversity of property appraisers, who are currently 90% white;
- Extend COVID-19 stimulus and relief efforts.**–LF**

ILLUSTRATION BY VALERIE MORGAN; PHOTO VIA ISTOCK

Researchers Convert Methane Without Greenhouse Gas Emissions

Pioneering Discovery Could Cut Energy Waste, Create Valuable Industrial Chemicals

SCIENTISTS AT THE University of Maryland have created a way to convert one of the primary greenhouse gases—methane—into a range of valuable commodity chemicals without releasing climate-changing emissions in the process.

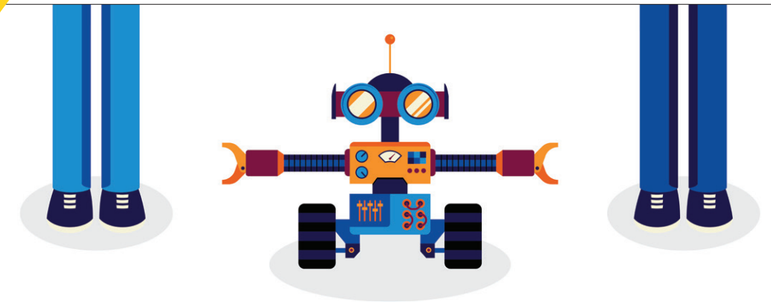
The achievement, detailed in October 2021 in the journal *Advanced Energy Materials*, is a major opportunity for the chemical and natural gas industries and a step forward in the fight to protect Earth's climate.

As the principal component of natural gas, methane is one of the most abundant hydrocarbon resources, but it is also a major environmental contaminant that accounts for about 20% of the heating effects of all greenhouse gases.

Recent extraction methods squander up to 3.5% of the resource worldwide and harm the environment. But a cheap, simple way to convert natural gas to value-added chemicals creates an economic incentive to conserve gas that might otherwise escape to the atmosphere.

Dongxia Liu, associate professor in chemical and biomolecular engineering, and Eric Wachsman, director of the Maryland Energy Innovation Institute and William L. Crentz Centennial Chair in Energy Research, developed a method using a membrane reactor that transforms methane into higher-value hydrocarbons and hydrogen in a single step without conventional, costly, complicated separation schemes.

The resulting chemicals, including ethylene and benzene, are used in the production of many consumer products, from pharmaceuticals to plastics.**–cos**



How a Robot Could Guard Human Health During Pandemics

System Automatically Detects Breaches of Social Distancing in Crowds

WHILE RESEARCH HAS shown that keeping a distance of at least two meters between people can help prevent the spread of COVID-19, YouTube videos of airplane passenger meltdowns and risky behavior in clubs and pool parties amply demonstrate that not everyone wants to follow rules—or hear criticism of their behavior from others.

Now, University of Maryland computing researchers have developed a system to encourage social distancing in crowds using gentle, text-based hints from an autonomous, mobile robot.

The team, including first author and Ph.D. student Adarsh Jagan Sathyamoorthy, graduate student Moumita Paul, research assistant Utsav Patel M.S. '19, Yash Savle M.S. '21 and Paul Chrisman Iribe Professor Dinesh Manocha in computer science and computer electrical engineering, presented the system in a paper published in December 2021 in *PLOS ONE*.

Equipped with an onboard camera and a LIDAR system—and able to tap into external CCTV cameras—the robot uses various algorithms to spot breaches of social distancing norms in crowds of people, and then automatically navigates to them and communicates about safe distancing practices through text on a display screen.

The system uses a machine learning method known as deep reinforcement learning, as well as an algorithm, Frozone, developed in Manocha's lab to help robots smoothly navigate through crowds.

The team is still working on methods to ensure smooth interactions with people; the robot shouldn't try to break up family groups, for instance, and will need to be subtle in its attempts to keep people apart, the researchers say. Still, keeping a watchful, unblinking eye on human health could be an ideal use for robotics, as well as a way to support people who are making great sacrifices to care for all of us.

"A lot of health care workers and security personnel had to put their health at risk to serve the public during the COVID-19 pandemic," they wrote in *PLOS ONE*. "Our work's core objective is to provide them with tools to safely and efficiently serve their communities."—**CC**

Diagnosis: Rude

Business Research Finds Everyday Unpleasantries Affect Doctors' Performance

WHY WOULD A DOCTOR treat you for anaphylactic shock if you're bleeding to death?

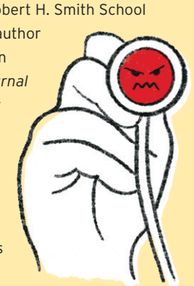
It might not be ineptitude. The answer could be as simple as getting yelled at by a superior.

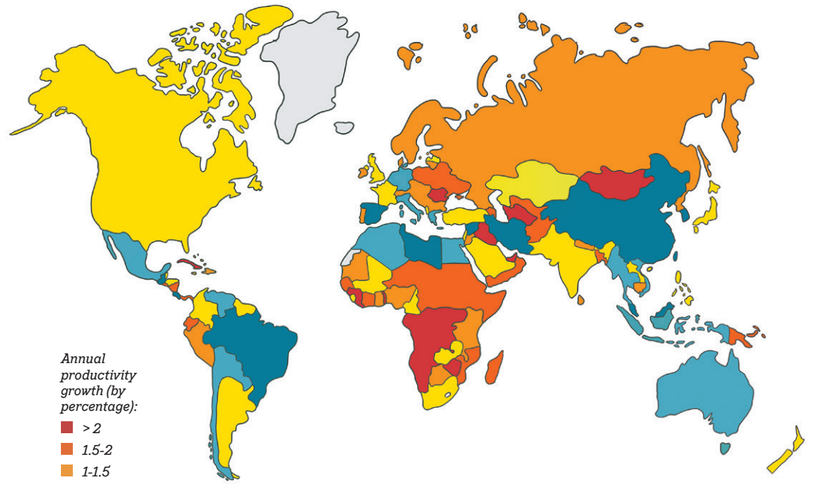
A single dose of rudeness can make doctors fixate on a wrong initial diagnosis, according to research from a UMD management professor and collaborators.

At a Florida hospital, they arranged an experiment with resident anesthesiologists, half of whom witnessed a staged encounter where a senior doctor upbraided a colleague preparing to examine a simulated patient with a reported penicillin reaction.

The result: Those who'd experienced rudeness tended to perceive only the initial diagnosis in front of them, and were less able make the correct diagnosis—internal bleeding.

"We're all subject to what's known as the anchoring bias, when we latch onto that first bit of information we get," says Trevor Foulk, assistant professor of management and organization in the Robert H. Smith School of Business and a co-author of a paper published in March 2021 in the *Journal of Applied Psychology* with colleagues from Carnegie Mellon University and the University of Florida. "But the experience of rudeness reinforces the bias."—**CC**





Climate Change Cut Agriculture Productivity

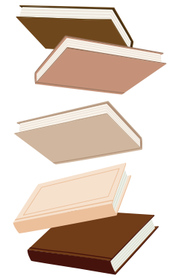
CLIMATE CHANGE HAS COST the world 21% of its potential agricultural productivity growth since 1961, equivalent to losing the last seven years of advances in output, according to new research from the University of Maryland and Cornell and Stanford universities.

The study, published in April 2021 in *Nature Climate Change*, is the first to quantify these human effects, showing particular vulnerability to weather-related factors in warmer regions like Africa, parts of Latin America and the Caribbean.

Robert Chambers, professor of agricultural and resource economics, and co-authors pioneered more accurate productivity calculations that include weather data.

"When a farmer makes an economic decision like what to plant in June, we won't necessarily know the outcome of that decision until six months later," Chambers says. "So there is a distinct break between input and output, and random events like weather can severely affect that."

The study finds that while global agricultural productivity growth experienced a 21% hit, many warmer climate regions dropped 26-34%. The United States was less affected, with productivity growth slipping 5-15%.—**SW**



Education Researchers Study How to Diversify Teaching Ranks

DECADES OF STUDIES show that students benefit not only from effective teachers, but from those sharing their racial or ethnic backgrounds. Now, with support from a $577,000 grant from the U.S. Department of Education, University of Maryland researchers are examining how to diversify the teacher workforce.

Teachers they can relate to constitute "one of the most impactful levers we can provide to students in terms of improving varied academic, social and behavioral outcomes," says David Blazar, assistant professor in the Department of Teaching and Learning, Policy and Leadership.

Blazar and collaborators, including UMD Center for Education Innovation and Improvement Director Segun Eubanks, will evaluate recruitment programs—including early exposure to teaching high school, college scholarships and career-changer programs—used by school districts and higher education institutions to grow a diverse teaching pool. They'll compare that to state of Maryland data to study how participation in recruitment programs contributes to academic and workforce outcomes for prospective teachers of color.—**CS**

TOP ILLUSTRATION BY JASON A. KIESLING; BOTTOM ILLUSTRATION BY VALERIE MORGAN

ILLUSTRATIONS BY VALERIE MORGAN

Putting Food Waste to Work

$6M in Grants Support Bioplastics Research

FROM LEFTOVERS forgotten until they're furry in the fridge to crops that spoil in storage, a shocking one-third of the world's food—nearly 1.5 billion tons yearly, according to a United Nations estimate—goes uneaten. Now, a University of Maryland professor is leading two new grants totaling $6 million from the U.S. Department of Energy that could take some of the bad taste out of all that food waste.

Traditional fuels and plastics rely mostly on petroleum—both finite and costly to the environment to extract and use. The two grants fund a consortium of scientists and industry partners led by Stephanie Lansing from the Department of Environmental Science and Technology to develop methods to create biofuels and bioplastics from food waste to benefit both the planet and people's pocketbooks.

"How can we take the resources we have and find a way to use them sustainably?" she says.

Lansing's research focuses on converting waste products into marketable products, either through a process called anaerobic digestion, which uses bacteria to break down waste and create natural gas, or by gasification, a controlled thermochemical reaction that produces the needed gases.

The fuel and plastics-focused grants include funding to allow the researchers to test the greener products against ones now for sale to see how marketable these new bioplastics and biofuels can be. "This project is really about giving food waste a value," Lansing says.**—SW**

ILLUSTRATION BY VALERIE MORGAN

Major Federal Research Partnerships

Several large cooperative agreements created or renewed collaboration in science and technology:

SUPPORTING SPACE RESEARCH AND EXPLORATION

A partnership between NASA's Goddard Space Flight Center and four universities—led by University of Maryland astronomers—was extended through March 2027 with a $178 million cooperative agreement. It will enable continuing collaborations and expand on the partnership's successes in missions exploring the solar system and the universe beyond.

The Center for Research and Exploration in Space Science and Technology (CRESST) was created in 2006; the last CRESST II partnership began in 2017 with an $87.5 million agreement. CRESST II partner institutions include the University of Maryland, Baltimore County (UMBC), the Catholic University of America, Howard University and the Southeastern Universities Research Association. Roughly 160 CRESST II scientists are involved in constructing and testing instruments for NASA missions, planning missions and developing technology to enable those missions.

ACCELERATING AI, AUTONOMY

A partnership led by UMD researchers has entered a cooperative agreement with the U.S. Army Research Laboratory that could provide up to $68 million over five years to drive advances in artificial intelligence and autonomy. An interdisciplinary research team from UMD and UMBC aims to create a new generation of technologies and devices—from wearables to unmanned aircraft—able to intelligently work alone or in teams with other devices, as well as safely and effectively collaborate with their human operators in different environments.

TRACKING SMALL CELESTIAL BODIES

NASA committed $32.5 million to extend a cooperative agreement with UMD, allowing it to continue overseeing the space agency's data on asteroids, comets, meteorites and other small objects in space. The agreement enables the UMD-managed Small Bodies Node of NASA's Planetary Data System to improve and expand services through 2026, including providing increased public access.

Researchers Open New Front in Global Battle Against Tuberculosis

UNIVERSITY OF MARYLAND SCIENTISTS have made a surprising discovery about how the bacterium that causes tuberculosis, a primarily respiratory disease that annually sickens 10 million people and kills 1 to 2 million, suppresses the body's immune system.

In a study published in July 2021 in *PLOS Pathogens*, the team led by postdoctoral fellow and first author Shivangi Rastogi showed a gene helps *Mycobacterium tuberculosis* turn off an important immune-signaling system in infected human cells, potentially exacerbating the infection.

This finding may point to a target for a gene-based treatment or preventative therapy for tuberculosis, for which available treatments are only 85% effective, while multidrug-resistant forms pose a public health threat in many parts of the world.

"In order to develop novel therapeutic targets, an understanding of the molecular mechanisms of how bacterial proteins interact with human cells is essential," says Volker Briken, a professor of cell biology and molecular genetics and senior author of the study.**—KC**

Planet Word's New Research World

NSF Award to Fund UMD-led Studies in Language Science at New D.C. Museum

WHY IS IT EASIER to understand the speech of people we know rather than strangers? How do non-signing people perceive the difficulty of learning American Sign Language? Do text messages affect us differently than formal writing?

These are some of the experiments that could stem from a new $440,000 grant from the National Science Foundation, which is funding a partnership to advance the science of language between University of Maryland researchers, Howard University, Gallaudet University and the Planet Word museum, with a key mission to advance public understanding of the subject.

"Language is already the topic of conversation at the museum, so there's an unparalleled opportunity for our studies and activities about language science to be a seamless and memorable part of visitors' experience," says project leader Charlotte Vaughn, assistant research professor in UMD's Maryland Language Science Center.

Planet Word opened in late 2020 in a historic school building in downtown Washington, D.C. Faculty from UMD's Maryland Language Science Center, the Department of Linguistics, the Department of Hearing and Speech Sciences and the Department of English were involved in shaping the museum's vision and programming.

Vaughn said the opportunity to partner with a historically Black university and the world's only liberal arts university for deaf and hard-of-hearing people will allow for significant progress on issues central to the field.

"Engaging the diverse Planet Word audience in our activities will make our research stronger, more representative and more widely accessible," Vaughn says.**—JW**

TOP PHOTO VIA SHUTTERSTOCK;
BOTTOM PHOTO COURTESY OF PLANET WORD

New Institutes, Centers Broaden UMD's Reach

THE UNIVERSITY OF MARYLAND in 2021 debuted or relaunched several centers or institutes devoted to multidisciplinary research in topics ranging from cutting-edge art to national defense:

▲ **MAYA BRIN INSTITUTE FOR NEW PERFORMANCE:** A family with deep ties to UMD is giving $9 million to its School of Theatre, Dance, and Performance Studies to boldly reimagine the future of education in the performing arts.

Mathematics Professor Emeritus Michael and Eugenia Brin and the Sergey Brin Family Foundation are establishing the Maya Brin Institute for New Performance to encourage innovation in design and performance and to prepare graduates for careers in emerging media formats such as webcasts, immersive design technology and virtual reality performance. The Brins are parents of Google co-founder Sergey '93 and Samuel '09.

QUANTUM LEAP CHALLENGE INSTITUTE: The university was tapped to lead a multi-institutional effort supported by a $25 million National Science Foundation (NSF) award to develop quantum simulation devices that exploit the unique behavior of complex quantum systems while speeding the introduction of general-use quantum computers.

The NSF Quantum Leap Challenge Institute for Robust Quantum Simulation brings together computer scientists, engineers and physicists from five academic institutions and the federal government to develop theoretical concepts, design innovative hardware, and provide education and training for a suite of novel devices.

BRAIN AND BEHAVIOR INSTITUTE: UMD is elevating its research and teaching programs in neuroscience with the establishment of the Brain and Behavior Institute, which promotes innovative, multidisciplinary approaches to the most pressing problems of nervous system function and disease.

For the past five years, the university had invested in the Brain and Behavior Initiative to foster interdisciplinary research in neuroscience across the College Park campus.

APPLIED RESEARCH LABORATORY FOR INTELLIGENCE AND SECURITY: Officials from the U.S. Department of Defense and the University of Maryland gathered in December to commemorate the opening of facilities that house the Applied Research Laboratory for Intelligence and Security (ARLIS).

Located in UMD's Discovery District, ARLIS is one of 14 designated Department of Defense University Affiliated Research Centers in the nation, and the only one dedicated to solving intelligence and security problems.

PHOTO BY JONATHAN HSU

How 'Home Alone' Helped Unlock Brain Scan Data

Using Hit Films, Neuroscientists' New Method Illuminates Brain Activity Over Time

BRAIN SCAN ANALYSES from functional magnetic resonance imaging (fMRI) typically look like a static distribution of brain signals captured in a single instant. UMD researchers seeking to understand mental activity over periods of time have turned to an unexpected source: Hollywood blockbusters.

In an October 2021 paper in *PLOS Computational Biology*, Luiz Pessoa, professor of psychology and director of the Maryland Neuroimaging Center, and Joseph JaJa, professor of electrical and computer engineering with an appointment in UMD's Institute for Advanced Computer Studies, presented a novel machine learning-based approach to uncover hidden temporal information.

They developed neural network algorithms inspired by human brain function and new statistical approaches, applying them to fMRI scans of subjects watching films including "Home Alone," "Star Wars" and "Ocean's Eleven."

They hypothesized that after a neural network had digested the data, it would recognize similar information in new fMRI scans that would otherwise remain latent. Instead of a snapshot, Pessoa and JaJa demonstrated how to extract information about brain responses over time in contexts similar to those in everyday life.

"The collaboration ... allows neuroscientists to work together with engineers to advance our understanding of the brain," Pessoa says of his work with JaJa.—**NU**

Don't Take the Clickbait

Tool Helps Users Detect Misleading Headlines, Videos

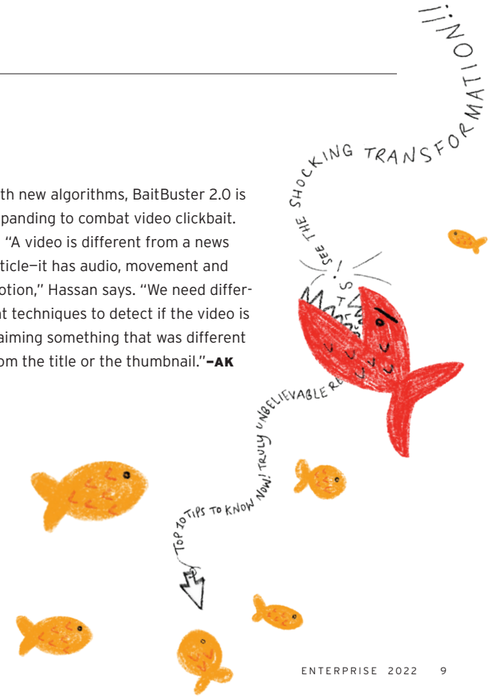
FIVE THINGS YOU need to know! You won't believe what happened next! Why we love ... misleading headlines!

While not always malicious, they can lure the absentminded social media scroller to click on irrelevant content, or even a scam. With a boost from a $228,000 National Science Foundation grant, a UMD researcher is developing a computational tool to help users avoid such clickbait in both text and video.

"We want to automatically detect these things so that our (online) experience becomes better and our social network becomes more secure," says Naeemul Hassan, an assistant professor of journalism and information studies and affiliate assistant professor of computer science.

Hassan is building on earlier work on BaitBuster, a browser extension that uses machine learning to give Facebook users a visual warning if article headlines and content don't match. Now, with new algorithms, BaitBuster 2.0 is expanding to combat video clickbait.

"A video is different from a news article—it has audio, movement and motion," Hassan says. "We need different techniques to detect if the video is claiming something that was different from the title or the thumbnail."—**AK**



"HOME ALONE" ILLUSTRATION BY VALERIE MORGAN; FISH ILLUSTRATION BY LAUREN BIAGINI

Piecing Together a Historic Puzzle

Analysis of Thousands of Glass, Ceramic Artifacts Sheds Light on Plantation Site

IN A HUSHED ROOM lined with filing cabinets, a group of Terps gathers around a table with a different kind of homework in front of them. Instead of books or laptops, they surround tray after tray of broken glass.

As they carefully analyze the shards, affixing tiny numeric labels with what looks like clear nail polish, in the background stand examples of what they're working toward: reconstructed old wine bottles, dark and jagged around the edges, held together with blue painter's tape.

"It's like having a jigsaw puzzle that's black, in three dimensions," says historic preservation Professor Donald Linebaugh, who, along with postdoctoral associate Stefan Woehlke, is leading the project—which is also piecing together the history of generations of American settlers, enslaved people and the Indigenous people they encountered.

The painstaking process is part of Linebaugh's 40-year study of the Kippax Plantation Archaeological Site, a Virginia property built in the late 17th century by Col. Robert Bolling and his wife, Jane Rolfe, the granddaughter of Pocahontas. With help from a Chesapeake Material Cultural Studies Grant from the Conservation Fund, the research team has completed a similar "vessel-ization" of thousands of excavated ceramic fragments. Now, they're going through the same steps with glass, hoping to uncover more clues about life on the plantation.

Olivia Meoni '21 (right) labels pieces of glass as part of the vesselization process to determine the number and type of vessels excavated; a grid (above, right) helps record where various artifacts were found.

"Glass was the plastic of its time," Woehlke says of the wine bottles, stemware, perfume containers and medicine jars they've found. "There's a lot you can learn from glass, especially once they start using molds that have labels built into them. You can at least get an idea of what the original use of that glass vessel was."

Linebaugh, who has been working on the site since he was a graduate student at the College of William and Mary, has brought dozens of his own students to the property over the years. The dishes, tools, beads and other artifacts they've uncovered have offered insights about the interconnectivity of European immigrants—from the Bollings in 1660 to a family called the Hereticks in 1917—Native Americans and African American slaves. In 1726, for instance, Robert Bolling's son Drury had an inventory that listed 13 enslaved men, women and children.

The glass vesselization is the study's latest stage. After the UMD team labels each of the thousands of shards with an adhesive called B-72, it'll be able to keep track of the fragments' original locations while attempting to piece whole artifacts back together. Just like puzzle solvers might try to work from a corner, the bases and rims of bottles, where glass is usually thickest and best preserved, are key as the researchers work to determine the number and type of vessels they have.

That process will add to the estimated 950 ceramic vessels the team has already identified over the past year. Though further analysis is needed, the researchers say, the items still provide some hints about plantation life; for example, most of the items found in the property's slave quarters are hollowware, such as bowls, suggesting more stews or soups were served than meat dishes.

"That follows the pattern of what we see at other slave quarters," Linebaugh says, "and it then links to people that are doing research on foodways among enslaved Africans during that period."

On the heels of a historic marker dedication ceremony at the Kippax Plantation in September 2021—then-Virginia Gov. Ralph Northam, Linebaugh and descendants of some of the plantation's residents were among the attendees—a group of ceramics experts visited campus to view the artifacts and contribute their specialized expertise to the project.

"It's the best of both worlds, because we have the historical record, which gives us names, gives us dates," Woehlke says. "But then the material culture can answer some of those questions about the past that people didn't think to write about because it was part of everyday existence."—**AK**

From top, artifacts recovered from the Kippax Plantation include: a late 19th- or early 20th-century molded glass clown figurine, similar to products coming out of Pukeberg Glassworks in Sweden at that time; a hand-painted European porcelain saucer, also from the 19th or early 20th century; a 17th-century glass-bead necklace, recovered in situ *to show the way it was originally strung; and a Bartmann (bearded face) jug, produced in Germany in the 17th century.*

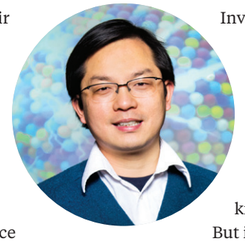
PHOTOS BY STEPHANIE S. CORDLE

Where Wood Gets Weird

Engineer Keeps Finding New Ways to Employ the Ultimate Sustainable Material

WHAT'S BOUNCY, bulletproof, cools you in the summer, keeps you toasty warm in winter and might help save our planet?

The answer literally grows on (and in) trees: wood—at least in the many unfamiliar guises it takes on in the lab of Liangbing "Bing" Hu, Herbert Rabin Distinguished Professor of materials science and engineering and director of the Center for Materials Innovation at UMD. Hu is an expert in nanomaterials, which generally are manufactured to have special characteristics—like ultrastrength or superconductivity—based on their microscopic structure.



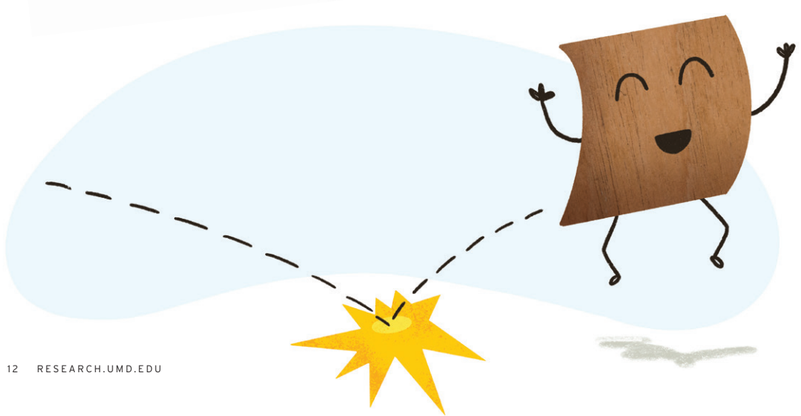
Hu got excited several years ago when he realized there was an almost infinite supply of natural nanomaterial that's both versatile and strong, and buried in the grain structure of wood. Since then, he's been developing different methods to access and exploit that hidden resource while developing surprising new applications that a UMD spinoff company, InventWood, is readying for market.

"Sustainability and environmental protection convinced me more and more to pursue this," he says. "Wood is an abundant and renewable material, and an old material people have gained a lot of knowledge about through history. But in terms of innovation, this is not a crowded field."

Read on for a few of the ways Hu and his collaborators have built on a trusty standby.—CC

"Super Wood"

Stronger than steel at one-sixth the weight, wood turns literally bulletproof when Hu and collaborators remove lignin, a natural "glue" that holds the cells together. They compress what remains under extreme pressure to create a rust-free structural material that could be deployed, with support from a $4 million grant from the Department of Energy, in everything from bridges to boats.



Let's Bounce

A process of heating, freezing and chemical modification turns wood's normally rigid structure to jelly so it rebounds like a superball. Hu had no specific goal for this recently announced discovery—other than squishiness—but now some companies are interested in exploring its use as a shock absorber.

PHOTO BY MIKE MORGAN

Growing Power

Hu led a team that created flexible, rechargeable lithium ion batteries from one of the primary products produced with wood: paper. As reported in *Nature* in October 2021, a part of wood too small to see with the naked eye—thread-like tubes known as cellulose nanofibrils—facilitates creation of solid-state batteries, which use solid rather than liquid electrolyte solutions, resulting in higher energy density and much greater safety.

Steamed Up

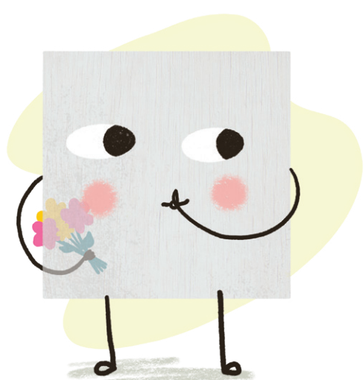
Wood from Hu's lab turns seawater to drinking water. Specially processed basswood, blackened by burning, floats inside a solar evaporator, sucking up saltwater through a vascular structure naturally designed to avoid clogging from impurities like salt. Under concentrated solar heat, the wood emits steam that condenses into freshwater.

Building Chiller

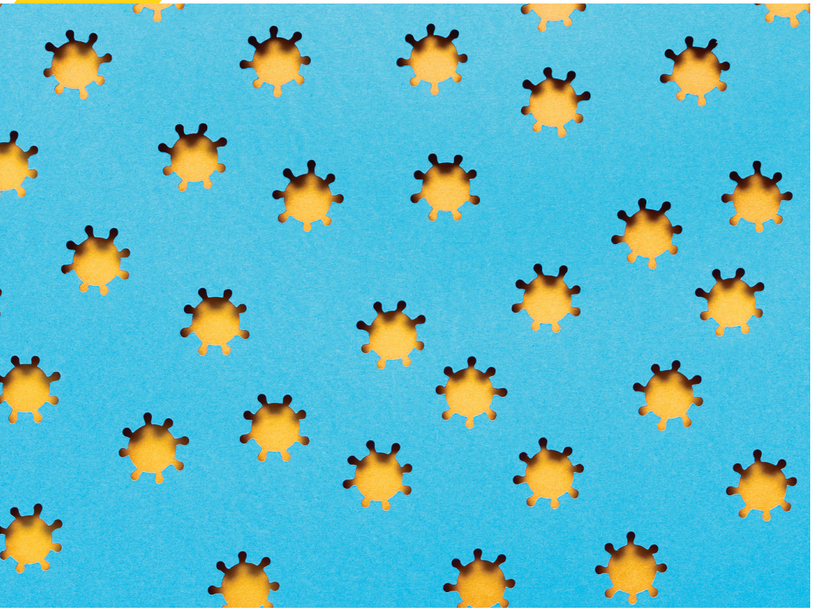
Hu's radiative cooling wood is pure white in the visual light spectrum, meaning that on building roofs, it doesn't soak up the sun. Paradoxically, it's pure black—but only in the invisible infrared spectrum—helping heat radiate back into outer space. The result is a several-degree difference between inside and out, even before switching on the AC.

Clear Cuts

Wood like you've never seen it—or in this case, seen through it. Hu and his students created nearly transparent wood by replacing its lignin with clear epoxy. The result is a beautiful building material that retains its wood grain and admits light like frosted glass, but insulates better and won't shatter.



ILLUSTRATIONS BY VALERIE MORGAN



Sniffing Out Aerosols' Role in Flu Transmission

Researcher's $15M Study Could End Confusion Over Spread of Viruses Like COVID-19

MEDICAL EXPERTS have long believed respiratory viral illnesses spread mainly through contact with contaminated surfaces or being sprayed by droplets from someone coughing and sneezing nearby. However, recent research has placed the spotlight on aerosols—tiny particles that remain suspended in the air after an infected person breathes or speaks—as the dominant transmission route.

Research over the last 20 years by UMD School of Public Health Professor Dr. Donald Milton has been central to this discussion, and now, he and collaborators from the University of Maryland School of Medicine and elsewhere could largely put the question to rest with help from a $15 million National Institutes of Health award.

The team is working to develop new technologies for collecting viruses from the air and conducting a five-year randomized, controlled trial. It's the latest of Milton's studies on the contents of exhaled breath; an earlier one was funded by an MPowering the State Initiative seed grant.

"The medical community doesn't yet fully understand aerosols and has been waiting for more evidence from a trial like this one," says Milton, who's leading the project. "My hope is that we can address this persistent controversy that has held up our ability to respond to respiratory pandemics."

School of Medicine researchers led by Dr. Wilbur Chen will recruit groups of healthy, unvaccinated people whose antibody levels make them susceptible to influenza to live in a quarantine facility starting in early 2023. They'll watch movies, play pool and do other activities for two weeks alongside people diagnosed with influenza.

Some healthy participants will wear face shields and wash their hands every 15 minutes, while others will lack those precautions. Part of the group will live in rooms with advanced ventilation systems designed by UMD mechanical engineering Professor Jelena Srebric, while others will inhabit poorly ventilated spaces.

"That way we can separate out what transmissions can be attributed to aerosols, or to spray and touch," Milton says.

This new research will build upon a 2020 study by Milton in *PLOS Pathogens* that evaluated flu transmission from healthy people in a controlled environment. Results from that study were some of the first to build evidence that aerosols play a leading role in transmission.

Other collaborators in the current study include scientists from the Mt. Sinai Icahn School of Medicine, University of Michigan School of Public Health, University of Wisconsin School of Veterinary Medicine, Hong Kong University School of Public Health and Aerosol Dynamics.**—CC, KB**

ILLUSTRATION VIA STOCKSY

Researchers Gauge 'Cybersickness' by Recording Brain Waves

Better Understanding of VR-Induced Discomfort Could Broaden Technology's Reach

IF YOU'VE EVER left a virtual world feeling nauseous or disoriented, you're familiar with cybersickness, and you're hardly alone. The intensity and immersion of virtual reality (VR) environments create a stomach-churning challenge for up to 80% of users.

In a first-of-its kind study, researchers at UMD recorded VR users' brain activity using electroencephalography (EEG) to work toward a cure. The research conducted by computer science alum Eric Krokos '13, M.S. '15, Ph.D. '18 and Amitabh Varshney, a professor of computer science and dean of the College of Computer, Mathematical, and Natural Sciences, was published in May 2021 in *Virtual Reality*.

In conjunction with researchers at the University of Maryland, Baltimore, UMD researchers are studying virtual reality as a tool to lessen sensations of pain, potentially reducing opioid use; the MPowering the State initiative provided part of the study's funding.

Instead of actual movement, cybersickness is triggered by the perception of movement in a virtual environment. While there are several theories about why it occurs, no quantified method has existed to study cybersickness.

Krokos and Varshney used EEG—which records electrical activity through sensors on the scalp—to establish a correlation between the recorded brain activity and self-reported symptoms of their participants. The work provides a new benchmark for cognitive psychologists, game developers and physicians.

"Establishing a strong correlation between cybersickness and EEG-measured brain activity is the first step toward interactively characterizing and mitigating cybersickness, and improving the VR experience for all," Varshney says.**—MH**

How Tech Can Fill Gaps in Mental Health Care

$1.2M from NSF Supports Work to Connect Patients, Clinicians

AS THE CLOUDS of mental illness gather, it can be difficult for patients to recognize their own symptoms and find help.

With $1.2 million from the National Science Foundation, UMD researchers are creating a computerized framework that could create a mental weather forecast of sorts. Using mobile technology and powered by machine learning, it will meld language and speech analysis with clinical expertise to help patients and clinicians connect and head off crises in a sparsely resourced U.S. mental health care system.

"We're addressing what has been called the 'clinical white space,' when people are between appointments and their doctors have little ability to help monitor what's happening with them," says Philip Resnik, a professor of linguistics with a joint appointment in the University of Maryland Institute for Advanced Computer Studies.

The project was born with the help of an AI + Medicine for High Impact (AIM-HI) Challenge Awards seed grant, which links UMD scholars with medical researchers at the University of Maryland, Baltimore (UMB) on research initiatives joining artificial intelligence and medicine. The project's other leaders are Deanna Kelly, a psychiatry professor at the University of Maryland School of Medicine at UMB, electrical and computer engineering Professor Carol-Espy Wilson and computer science Assistant Professor John Dickerson, both at UMD.**—CC**

TOP PHOTO: COURTESY OF MARYLAND BLENDED REALITY CENTER; ILLUSTRATION BY VALERIE MORGAN

Growing Justice From Grassroots Science

Trash and toxic substances are often dumped where poor people and communities of color live. Public health researcher Sacoby Wilson is empowering them to fight for cleaner, safer conditions.

BY LIAM FARRELL

Bordering a major East Coast port and braided with highways, Baltimore's southern edge is a rushing two-way conduit for products constantly flowing in and the detritus of modern life continually flushing out. Much of this effluent is headed for the neighborhood of Curtis Bay, home to a trifecta of foul final destinations: a landfill, a medical waste facility and an animal rendering plant.

When Destiny Watford was growing up there more than a decade ago, adults urged her to get out as soon as possible. Brick rowhomes, churches, corner stores and school playgrounds share the air with a coal silo and fleets of diesel trucks, and Watford saw neighbors die of lung cancer and her mother struggle with asthma attacks.

The community already had some of the nation's most polluted and deadly air, according to a collection of studies, when plans were announced in 2012 for a new trash incinerator—permitted to burn 4,000 tons a day and spew up to 1,240 pounds of lead and mercury annually—less than a mile from her high school. Anger overcoming her shy nature, then-16-year-old Watford co-founded an activist group and looked for allies in what became a four-year quest to stop it.

One important guide would be Sacoby Wilson, an assistant professor in the University of Maryland's School of Public Health. An expert on environmental toxins and the sociopolitical structures that make them so abundant where people of color live, Wilson helped the teenagers make contacts with legal and environmental groups and get their hands on the data they needed to mount a challenge to an international corporation.

"We weren't lawyers or experts in any way, shape or form," Watford says. "Sacoby ended up being one of those folks. He was really influential in making sure we had those connections."

Now an associate professor with the Maryland Institute for Applied Environmental Health and Department of Epidemiology and Biostatistics, Wilson is at the forefront of investigating how the places where people live can determine their health. A proponent of community-based participatory research, he trains and assists people in getting the information they need to protect their families and homes. Wilson and his Center for Community Engagement, Environmental Justice and Health (CEEJH) have worked alongside overburdened and underserved people of color and low-wealth

PHOTO BY JOHN T. CONSOLI

populations from Houston and New Orleans to Washington, D.C., aiming for the nexus of pollution, zoning and community development practices that disproportionately hurt vulnerable neighborhoods and reflect the ingrained biases of government and private industry actors.

By teaching people how to take water samples, read air monitor data from their homes and understand complex legal and regulatory structures, Wilson tries to do more than just document what happens to someone who lives near or works in a power plant or hog farm. Ultimately, as climate change intensifies and new threats like COVID-19 show how deadly historic health disparities can be, Wilson wants to help people "liberate themselves from the toxic trauma they are experiencing every day."

"In working with people, you got to provide services," he says. "(It's) about solutions, about action, about mitigation, about investments."

Sacoby Wilson plays as a toddler (left) at a relative's house in Vicksburg, Miss., in the late 1970s. He lost his hair to alopecia a few years later, spurring his interest in connections between public health and the environment. He received his Ph.D. in 2005 (below) in a ceremony at the University of North Carolina in Chapel Hill; the education he gained working with local residents and activists was as valuable as his academic training, Wilson says.

> "It's about where we live, where we work, where we play, where we pray, where we learn … We're talking about food, faith, family, health and jobs.
>
> ***—Sacoby Wilson***
> *Associate Professor, Maryland Institute for Applied Environmental Health and Department of Epidemiology and Biostatistics*

Wilson, who grew up in Vicksburg, Miss., in the late 1970s and early 1980s, remembers some idyllic moments from his childhood, like trekking into the woods with friends to catch crawfish and pick wild blackberries—escapes he compares to scenes out of Mark Twain's Southern tales.

But he also remembers the racism, especially when he played sports, as taunts and slurs rained down from not only spectators and opposing players but also coaches and referees. He wasn't singled out just for his skin color, either; at age 7, he was diagnosed with alopecia, causing his hair to start falling out as his immune system attacked his follicles.

"Frightening, confusing, ostracizing—(it was) all those things," Wilson says. "I went through all that stuff that kids go through when they are different."

But his bright and precocious nature survived, says Bobbie Wilson, Sacoby's mother. He spoke and read early in childhood, built his own lawnmower business and traveled 200 miles from home to board at an advanced science and math high school, full of determination and curiosity.

"He gave the teachers holy hell, as he would put it, because he was always trying to figure out this and figure out that," Bobbie says. "He didn't have any problem expressing himself. He is one of those people who would not stop talking."

And he applied a burgeoning interest in biology and ecology to himself: What had made his body turn against itself? Was it bigotry? Or did his immune system rebel against toxins seeping in from the nearby highway, landfill, and concrete and sewer treatment plants?

Wilson has never been able to get clear answers to those questions, but a movement then gathering momentum would have said that they were worth asking.

The concept of "environmental justice" has antecedents in fights over working conditions during England's Industrial Revolution and the horrors of early 20th century tenement housing in urban America, but it wasn't until the 1960s civil rights movement that leaders like Martin Luther King Jr. began to draw clearer lines between who had to live and work in the most dangerous places and jobs and what it was doing to them.

In 1979, a group of Black homeowners in Houston filed a first-of-its-kind lawsuit alleging that building a landfill in their community, and within 1,500 feet of a public school, violated their civil rights. The challenge ultimately failed, but Robert Bullard, a sociologist and husband of the plaintiffs' attorney and now known as the "father of environmental justice," went about further documenting the city's waste sites and their placement within African American neighborhoods.

The United Church of Christ Commission on Racial Justice provided the first national glimpse of the problem, releasing a 1987 report detailing how race was the most salient predictive factor for the location of industrial pollution sites, with three out of every five Black and Hispanic Americans living near uncontrolled toxic waste.

"These communities cannot afford the luxury of being primarily concerned about the quality of their environment when confronted by a plethora of pressing problems related to their day-to-day survival," the report stated. "Within this context, racial and ethnic communities become particularly vulnerable to those who advocate the siting of a hazardous waste facility as an avenue for employment and economic development."

So as Wilson headed off to Alabama A&M to earn his undergraduate degree in biology and ecotoxicology, followed by master's and doctoral degrees in environmental health sciences from the University of North Carolina, the personal was melded with the scientific.

"He showed up. He would initiate things. He was enthusiastic. He had a great deal of knowledge," says Victor Schoenbach, who was a professor in the UNC Department of Epidemiology and advised the Minority Student Caucus led by Wilson. "I have a hard time thinking of what he didn't do."

About 20 miles northwest of Chapel Hill's campus are the neighborhoods where Wilson says he got his "other Ph.D." While his actual doctorate was based on research into industrial hog farming, the historically Black communities outside of Mebane, N.C., were where he learned how to listen to and partner with people on the ground.

Omega Wilson and his wife, Brenda, were living under nearby Mebane's zoning and land-use control yet denied services like public water and sewer through a process known as "extraterritorial jurisdiction," when they founded the West End Revitalization Association in 1994 to oppose a highway project and advocate for basic amenities.

"We were treated like the worst of the worst," he says, "like we were no better than trash and sewage."

The two Wilsons met at an environmental justice conference in 2000, bonding over shared Mississippi roots and then collaborating on a water quality study. They found not only water in the West End and other neighborhoods contaminated by feces and bacteria such as *E. coli* and *Enterococci*, but also failing pipes made of paper and tar. From conducting door-to-door surveys and training residents to take their own samples to the shocking results, Wilson says the partnership with Omega was his "real training working in a community."

"That's a big part of my foundation," Wilson says. "You got parts of the country that aren't in the 20th century, they are in the 19th century."

That's why Wilson focuses on what he calls "INpowerment": Rather than just documenting problems and seeking academic understanding, he provides data and teaches the tools of academic inquiry directly to people affected by pollution so they have the knowledge necessary to take on a real fight for better health.

He's applied that philosophy in a

Funding Seeds Expanded Research

Sacoby Wilson's Center for Community Engagement, Environmental Justice and Health (CEEJH) has attracted more than $3.5 million in recent months from private and public agencies to study and combat pollution in disadvantaged communities:

- A $1.75 million gift from Meta (formerly Facebook) will support new and ongoing activities at CEEJH, including a paid internship program, new staff and the annual University of Maryland Symposium on Environmental Justice and Health Disparities.
- An $800,000 gift from the Bezos Earth Fund will help increase air quality monitoring in communities exposed to traffic-related pollution across the mid-Atlantic region.
- An $800,000 grant from the U.S. Environmental Protection Agency is funding a three-year study in partnership with Duke University to analyze the risk of toxic exposures due to natural disasters.
- A $100,000 contract from the Environmental Protection Agency will expand the scope and information of the MD EJ SCREEN mapping tool that allows comparisons between different parts of the state on pollution burdens and socioeconomic and health factors.

PHOTOS COURTESY OF SACOBY WILSON

targeted manner, such as working with Millsboro, Del., residents for a July 2015 health assessment on a proposed poultry processing plant in an area already contaminated by dangerous chemicals like lead, chromium and arsenic. He's also put it into practice more broadly through his center's Maryland Environmental Justice Screen Tool. That allows anyone to pull up a map online and see how areas compare in pollution burdens like diesel particulates, proximity to treatment and disposal facilities, and watershed failures, while adding socioeconomic and contextual layers like education and income levels, supermarket locations and public transit stops. This way, Wilson says, money for green investment and mitigation in the state can be targeted to the communities that need it most.

Created in 2017 with colleagues from UMD and the Maryland Environmental Health Network, the map will be enhanced through a new $100,000 Environmental Protection Agency contract to add more rural issues such as pesticide exposure and proximity to large-scale animal feeding operations, in addition to children's health markers like blood lead levels and maternal and infant mortality rates.

"This is the moment to seize on the fact that clean air is health care, and that climate justice and environmental justice also includes rural justice," Ben Grumbles, Maryland secretary of the environment, said at a November event announcing the project.

The key to Wilson's work, however, is not just his proficiency at gathering and analyzing data, but also his personal investment. Omega and his wife compare him to a "pastor in the pulpit," and that passion is evident whenever he speaks in public, whether addressing a group of students at the University of California Irvine or giving a basic definition of environmental justice on a Mississippi legislator's radio show.

> He lived with those disparities. He's not just talking about them from an academic point of view. It's in his heart.
>
> —**Omega Wilson**
> *Co-founder, West End Revitalization Association*

"It's about where we live, where we work, where we play, where we pray, where we learn," he says. "It's proximal, it's every day … We're talking about food, faith, family, health and jobs."

With the backing of Wilson and the community's research and advocacy, new sewer lines have been installed for more than 100 homes in the Mebane area.

"He lived with those disparities. He's not just talking about them from and academic point of view," Omega says. "It's in his heart. You don't see that very often."

Karen Moe describes the smell that occasionally invades her house in Cheverly, Md., as similar to burning coffee—even though it's definitely not from a Starbucks.

Sitting between the District of Columbia and College Park, portions of Cheverly are home to industrial operations like e-waste and scrap metal recycling, concrete manufacturing facilities, and emissions from commuters and delivery vehicles. Moe, who has lived there for 35 years, knows plenty of people suffering from asthma and respiratory problems.

"People wash cars and the next day, they can wipe the dust off of it," she says.

So since last year, Moe has been one of about two dozen Cheverly residents helping to build a "hyperlocal" air quality monitoring network. CEEJH staff installed small, low-cost sensors on homes that draw in air with a fan and use a laser to measure particles, and provided training so residents can access and analyze real-time data posted online. Coupled with more MDE inspections and warnings to local business about idling diesel trucks and errant dust, Moe says she is already feeling "more looked after" and hopes the information can be used to provide air quality warnings and show MDE where violations might be occurring.

"We can provide information that will help people who have sensitive conditions," Moe says. "Give them guidance—don't work outside today, limit your outdoor time."

Environmental justice, Wilson says, requires long-term vision and support, and CEEJH is capable of that. Meta, the company formerly known as Facebook, recently made a $1.75 million gift to the center, supporting a new paid internship program, staff hires and its annual symposium.

"You're trying to make up for 40, 50 years of stuff. It's generational to even get incremental change," he says. "That's how insoluble, how deep, how entrenched these issues are."

Wilson is an expert at preparing people for this "marathon," says Omar Muhammad, the executive director of the North Charleston, S.C., LowCountry Alliance for Model Communities, which has partnered with Wilson for more than a decade on air pollution monitoring efforts, health disparity mapping and environmental health education.

"We're learning the process of how zoning works, we're learning the process of how to challenge a highway that's being built in our communities," Muhammad says. "When another project comes, we're not challenged with these huge learning curves."

For Destiny Watford, Wilson helped her learn that the disheartened assumptions she first heard from people in her neighborhood about the incinerator fight—"It's too big," "We're poor," "They are going to win"—did not, in fact, predict failure.

When the activists discovered that the Baltimore school system and other public agencies were planning to purchase energy from the incinerator, Wilson helped produce the research needed to protest and lobby the government to cancel its contracts. The incinerator's permits eventually expired without construction in 2016; today, Watford, who won a global environmental prize for her efforts, works for Greenpeace in Colorado.

"It was fundamental—not only for my own development as a person, but for realizing that people have power," she says. "Things aren't set in stone. We can change things for the better." ■

Sacoby Wilson works with students conducting local air monitoring in Langley Park, Md.

Researcher's Environmental Justice Footprints

Wilson and his students and colleagues have tackled issues from the mid-Atlantic to the Deep South. Along the Gulf Coast, projects involved coastal rehabilitation, food insecurity and quality of life in minoritized communities. In the Carolinas, they partnered with residents to address the effects of concentrated hog farming as well as to bolster disaster resilience after a North Carolina chlorine spill. Closer to College Park, the group studied potential health risks for urban anglers and the impact of air pollution from buses and commercial vehicles.

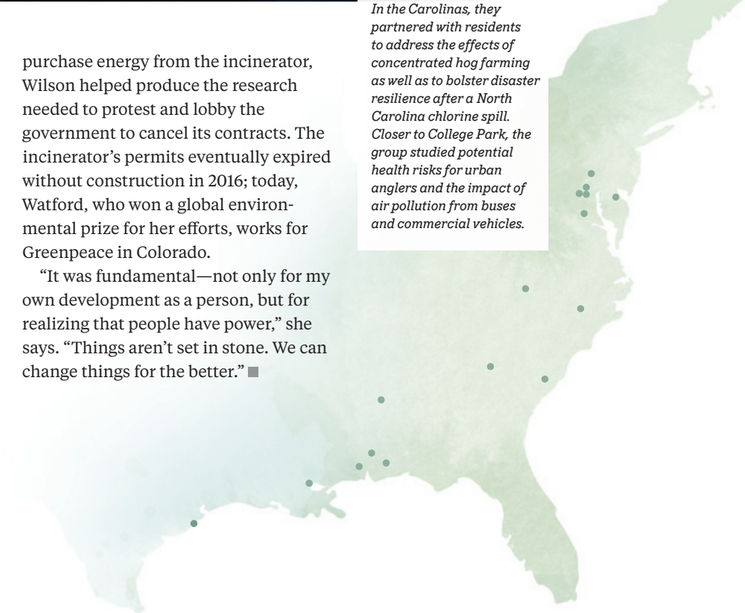
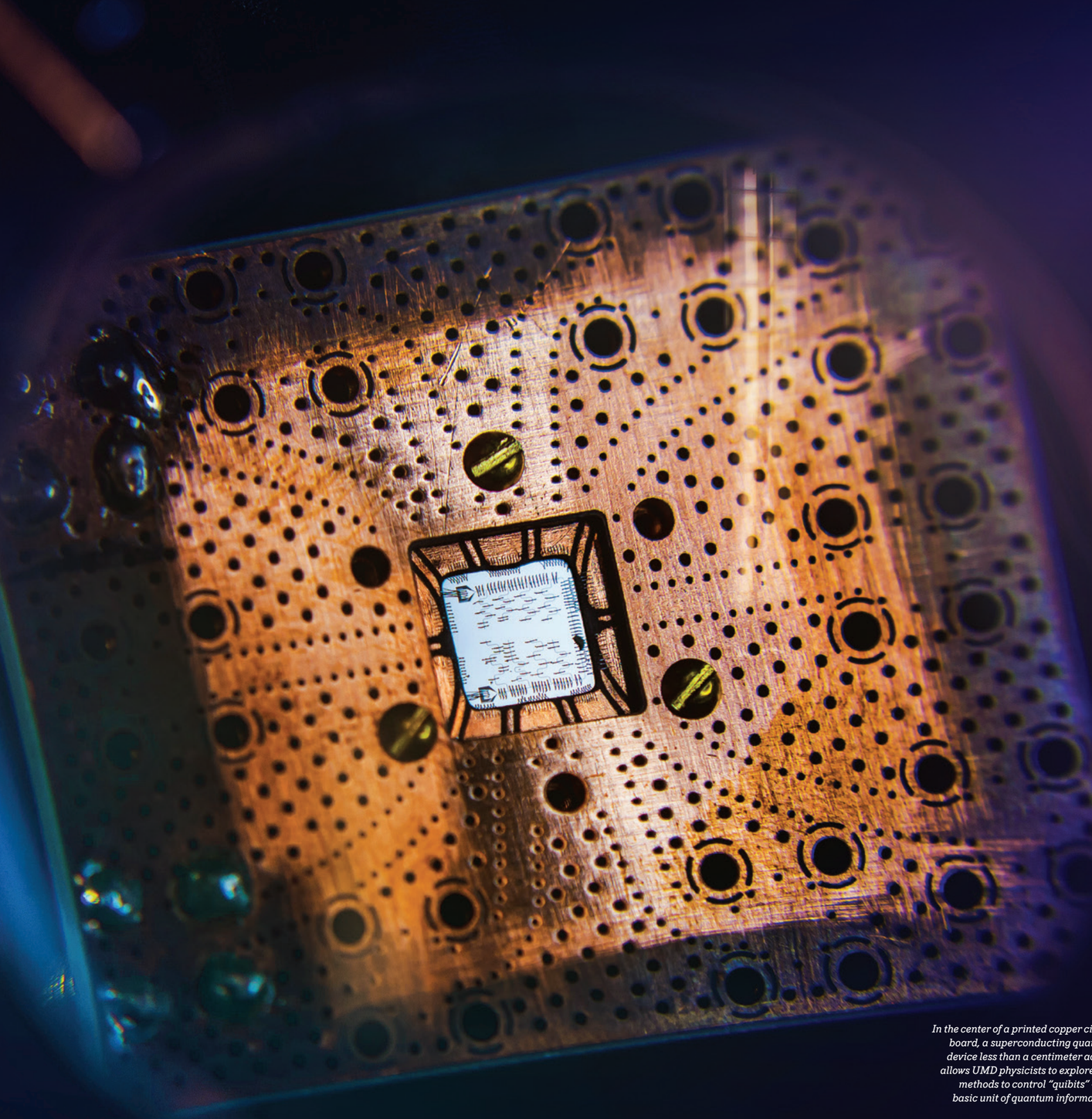


PHOTO COURTESY OF SCHOOL OF PUBLIC HEALTH

Mapping the Quantum Frontier

UMD EXPANDS ITS FOOTPRINT AS THE "CAPITAL OF QUANTUM" WITH THE LATEST LAB AND INSTITUTE TO ADVANCE MIND-BENDING COMPUTING.

BY CHRIS CARROLL PHOTOS BY JOHN T. CONSOLI



In the center of a printed copper circuit board, a superconducting quantum device less than a centimeter across allows UMD physicists to explore new methods to control "qubits"—the basic unit of quantum information.

> There's a mismatch between the reality of the technology and what quantum computer science and information science want to do with large, ideal systems that don't exist yet.
>
> —*Franz Klein*
> *Q-Lab Director, High-Performance Computing Engineer*

IT'S HARD TO ENVISION a time when computers didn't more or less disappear into beige office landscapes or pile up, obsolete in closets like increasingly ancient geological strata. The technological behemoths that Franz Klein works with, however, still evoke a twinge of dawn-of-the-space-age wonder.

As a high-performance computing engineer in the University of Maryland's Division of Information Technology, he helps run massive computing clusters linked by kilometers of cable that gobble enough electricity to run hundreds of average houses while crunching exponentially more data than your laptop. Astronomers, geneticists, climatologists and others queue up for solutions only supercomputers like UMD's soon-to-debut Zaratan, not to mention larger clusters at government laboratories and high-tech firms, can spit out.

Yet with all this digital horsepower at his fingertips, Klein now is venturing in a new direction with his recent concurrent appointment directing the National Quantum Lab at Maryland, aka the Q-Lab. Along with the National Science Foundation (NSF)-funded Quantum Leap Challenge Institute for Robust Quantum Simulation (RQS), it's one of two recent initiatives centered at UMD to accelerate the nascent field of quantum computing and help map out an unfamiliar new world. As various quantum technologies take off, a new class of computers enabled by the latest advances in physics is expected to revolutionize every aspect of life, just as today's devices led to the internet, mobile technology and advanced manufacturing.

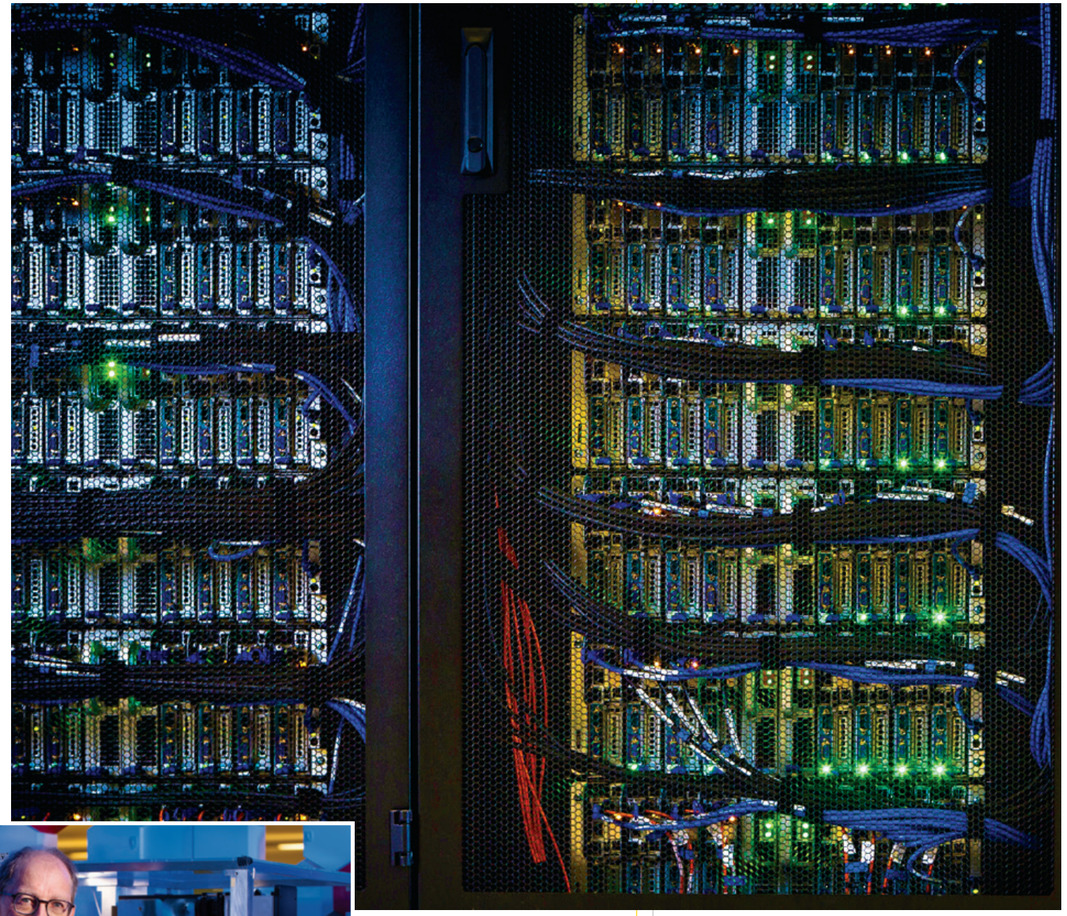
But this world of possibility has plenty of technological terra incognita, including limitations that echo the 1940s, when the first computers sparked to life, Klein says.

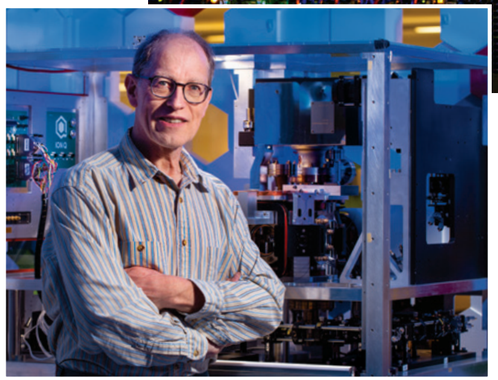
"There's a mismatch between the reality of the technology and what quantum computer science and information science want to do with large, ideal systems that don't exist yet," he says.

UMD's aggressive new push, he adds, could help reality catch up.

Hardcore Engineering, 'Wacky' Ideas

Klein isn't the first to note this mismatch, and the initiatives approach it from very different angles: The RQS, a multi-institutional project led by UMD and supported by $25 million from the NSF, takes a basic science approach with computer scientists, physicists, engineers and chemists exploring the universe at the scale of atoms while experimenting with different technologies and systems. It's all connected by the interim step toward powerful quantum computers known as quantum simulation—using the current hardware to "simulate" and study quantum systems in nature, from the workings of molecules to how light behaves.

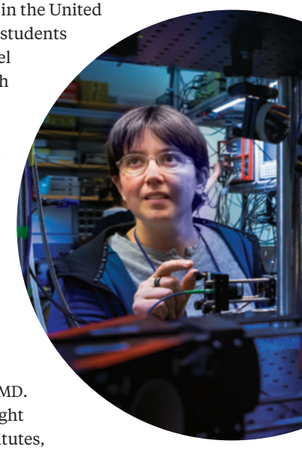




Franz Klein (left) oversees UMD supercomputers (above) and is now working with a new breed of machines as director of the Q-Lab.

Alicia J. Kollár (above right), a co-investigator in the new Quantum Leap Challenge Institute for Robust Quantum Simulation, is working to develop a new type of qubit.

The Q-Lab, which opened in May in the university's Discovery District with a $20 million investment from UMD, is a partnership with university spinoff IonQ. The lab centers on the company's campaign to translate discoveries that emerged from the Department of Physics into the first breakthrough quantum computer, establishing real-world viability for the technology. UMD researchers, partners and students, meanwhile, have access to the hardware and research opportunities that result from IonQ's race with tech giants like IBM and Google.

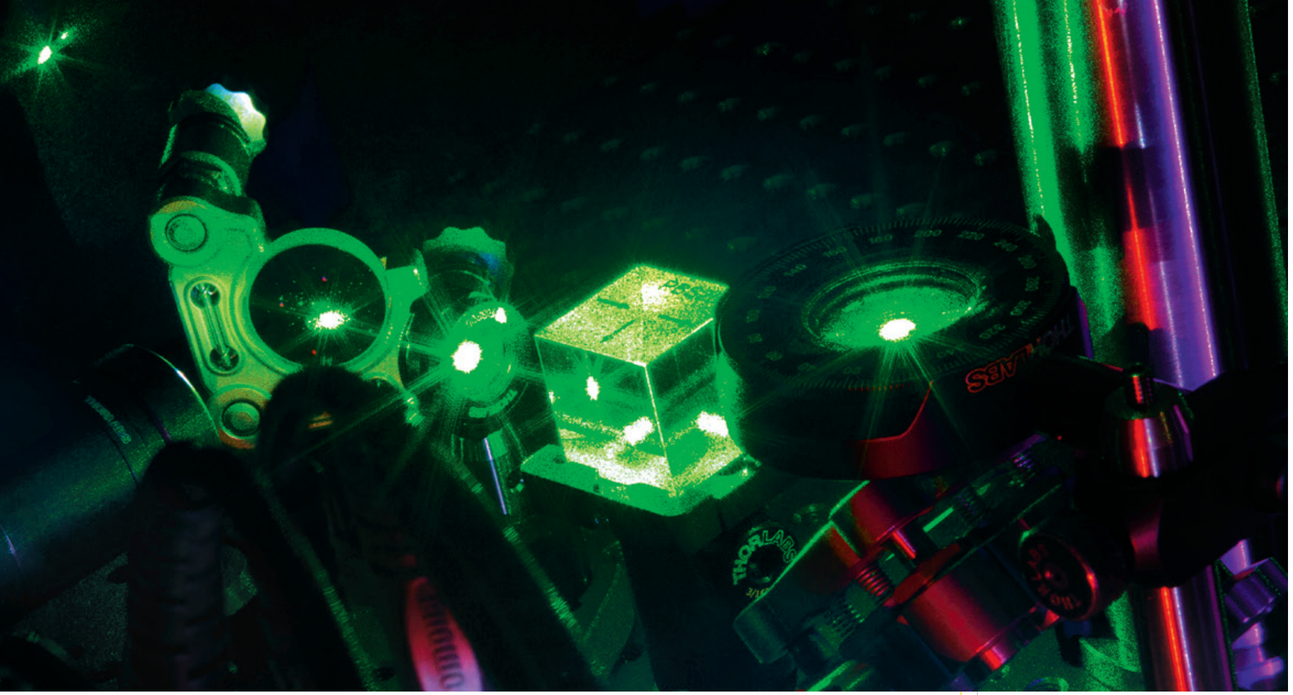


"No other university in the United States is able to provide students and researchers this level of hands-on contact with commercial-grade quantum computing technology and insights from experts working in this emerging field," University of Maryland President Darryll J. Pines said last fall in announcing the lab.

Both efforts draw on one of the largest quantum research efforts in the world at UMD. The university boasts eight related centers and institutes, a long-running partnership with the National Institute of Standards and Technology, and hundreds of researchers who delve into all aspects of quantum science and technology, from discovering new superconducting materials to exploring the mathematical and conceptual underpinnings of matter.

The foundations of the RQS and Q-Lab appear very different—"let's see what we can find" science vs. "let's reach the goal" engineering—because it's impossible to predict how technological revolutions are born, says Alicia J. Kollár, a RQS co-investigator and Chesapeake Assistant Professor of Physics. For example, a 1950s experiment at Bell Labs resulted in the discovery of a transistor-manufacturing process that helped make modern computers possible, only after an apparent disaster. "They couldn't figure it out, and then one day, their apparatus exploded—and then it worked," she says.

"If you're truly going to build a digital quantum computer, you can't do it without hardcore engineering; you also need the wacky ideas and discoveries from doing science," Kollár says.



Qubit Connection

A wide developmental gulf divides quantum computing from the "classical" computing that runs phones, smart fridges and supercomputers. With tech roots stretching back 80 years to the dawn of transistors, even a standard processor on sale at Best Buy can handle billions of "bits"—zeros and ones that are the basic units of information in standard computing. But quantum computers? You and some friends could count on your fingers how many "qubits," or quantum bits, they have.

But thanks to non-intuitive quantum effects like "superposition," which essentially allows a qubit to be both a zero and a one simultaneously, and "entanglement," which means qubits can be correlated in classically impossible ways, each qubit far surpasses a bit in terms of information-processing potential.

A machine of just a few thousand qubits should outperform the biggest classical supercomputer: cracking modern cryptography, perhaps supercharging artificial intelligence and machine learning, or mastering chemistry at an unprecedented level.

But getting to 1,000 reliable qubits, for now, is as daunting as Everest before Hillary and Tenzing.

Qubits must maintain delicate quantum states for the computer to operate; errors result from vibrations, temperature fluctuations or other environmental variables. The upshot, many believe, is that each functional qubit will need many more backup qubits to correct errors, unless a more reliable qubit technology comes to dominate. So 1,000 "logical" qubits might translate into 10,000, or even 100,000 individual qubits.

Accessible Goals

But what if we dropped the requirement that a quantum computer be as reliable as a regular computer? What if we worked up to Everest by first climbing hills? Broadly, that describes the RQS's approach, says its director and principal investigator, Andrew Childs, a professor of computer science who also co-leads the Joint Center for Quantum Information and Computer Science, a UMD-NIST partnership.

When quantum computers were first proposed in the 1980s, the idea was to use them to understand quantum systems too complex for classical computers, Childs says.

"One approach to that is you build a large-scale, fault-tolerant quantum computer that you can program any way you want to simulate quantum mechanics," he says.

Since such computers don't yet exist, scientists at Maryland have led the way with an alternative approach that is already feasible: analog quantum simulation. "In this case, instead of a digital computer you can use for anything, you build a system that will reproduce the features of the quantum system you want to study," he says. "Maybe it's somewhat programmable in that you have some knobs you twist to adjust the parameters, but it's still mocking up a system rather than providing the complete flexibility of a full digital computer."

Kollár, who is focusing on developing a new kind of superconducting qubit, calls herself "an analog hardware person at heart."

"With a digital quantum computer, the goal is complete control, and the qubit does exactly what you want," she says. "A quantum simulator is much more about letting nature run its course and figuring out what it's doing—but trying to find an interesting course."

Even a modest knob-twisting simulator, Childs points out, is still a quantum processor, even if it's not what he envisions in his theoretical work on algorithms for ideal systems. "For now, it's an accessible way to move forward … and at the same time, understand some of the big-picture questions."

Computer science Professor Andrew Childs is directing a new NSF-funded initiative exploring "quantum simulation"—a step toward robust quantum computing that could result in wide-ranging discoveries of its own.

Expanding the Network

For applications beyond research, reliability is king. That's an area in which IonQ has been generating big waves from its headquarters (above right) off Campus Drive. The company's "trapped ion" technology—ytterbium and barium atoms suspended in a vacuum and controlled by lasers—creates a qubit that can remain stable for days, compared to the milliseconds that competitors' superconductor-based qubits manage. As reported in a recent publication about creating fault tolerance by Monroe and colleagues in *Nature*, the technology is raising hopes that IonQ might lead the field past the crippling error problem.

So it's remarkable that even UMD undergrads at the Q-Lab have been handed the keys to a system that can make a claim to being the world's best—a level of institution-wide access that will continue to expand.

"It's going to push the state of the art," says Ron Walsworth, director of UMD's Quantum Technology Center (QTC) and a professor in engineering and physics who serves on the lab's leadership committee. "Having a company develop technology and say, 'Here's what it's good for' only works to a degree. In the Q-Lab, users with their various applications are going to find out for themselves what these early-stage quantum computers are good for. Having a diverse user base is going to be very helpful."

What's in it for the company? With its enormous, broad-ranging quantum enterprise, UMD is a knowledge base and resource for chasing wild new ideas that a laser-focused tech company can't afford in-house, says David Steuerman, IonQ director of academic and national lab partnerships.

"Any application we want to explore, we can knock on a door and say, 'Hey, come on over to the Q-Lab and work with us, because we want to work with you,'" he says. "We have great hardware, so we think they'll want to work with us."

Perhaps one of the facility's grandest features will be a node connecting IonQ to a pioneering quantum network—the first step toward a quantum internet—under development at the QTC in an NSF-funded project led by engineering and physics Professor Edo Waks. Says Walsworth, "The plan is to make this the largest, longest-distance quantum network in the world"—filling in another broad swath of white space in the map of the quantum future. ■

> In the Q-Lab, users with their various applications are going to find out for themselves what these early-stage quantum computers are good for.
>
> ***—Ron Walsworth***
> *Quantum Technology Center Director, Professor of Engineering and Physics*

Accolades

University of Maryland faculty and staff researchers earned an array of awards and honors in 2021

Darnell-Kanal Professor **DANIEL ABADI** and Professor Emerita **BONNIE DORR** in the Department of Computer Science join 93 other researchers worldwide who were named 2020 fellows by the Association for Computing Machinery, an elite recognition of outstanding science and scholarship that is bestowed upon less than 1% of the organization's 100,000 members.

Computer science Professor **ASHOK K. AGRAWALA** received an honorary doctorate in recognition of his outstanding contributions in the field of computer science from Dayalbagh Educational Institute in India.

Animal and avian sciences Professor **ROSELINA ANGEL** was recognized with the 2021 Poultry Science Association Distinguished Poultry Industry Career Award from the U.S. Poultry & Egg Association.

THOMAS ANTONSEN, professor of electrophysics in the Department of Electrical and Computer Engineering, received the 2022 IEEE Marie Sklodowska-Curie Award.

ELIZABETH APARICIO, assistant professor in behavioral and community health, was selected as a 2021 Society for Social Work and Research fellow.

AKUA ASA-AWUKU, associate professor of chemical and biomolecular engineering; **CANDICE DUNCAN**, a lecturer in the Department of Environmental Science and Technology; and **EBONY TERRELL SHOCKLEY**, associate clinical professor in the College of Education, were honored as Taking Nature Black Environmental Champions by the Audubon Naturalist Society. They make up the University of Maryland Geo-Sciences Research Team working to diversify the geosciences.

Professor of German studies **HESTER BAER** was named co-editor of *The German Quarterly*, the flagship journal in the field.

VAN BAILEY, director of Bias Incident Support Services, was featured in *Out Magazine*'s OUT100 list as one of the LGBTQ+ policymakers and advocates changing the world.

Minta Martin Professor and Department of Mechanical Engineering Chair **BALAKUMAR BALACHANDRAN** won both the 2021 J.P. Den Hartog and 2021 Lyapunov Awards from the American Society of Mechanical Engineering.

GAH-YI BAN, associate professor in the Department of Decision, Operations and Information Technologies, won the 2021 Best Operations Management paper in Operations Research from the Institute for Operations Research and the Management Sciences.

Stamp of Excellence

Pioneering Marine Researcher Honored With U.S. Postage Stamp

THE U.S. POSTAL SERVICE is issuing a stamp in 2022 featuring the late Eugenie Clark, aka the "Shark Lady," who taught marine biology at the university from 1968 until her 1992 retirement. The colorful researcher brought millions of people face to face with sharks through her popular classes, bestselling books, *National Geographic* articles and public television specials. Clark, who also contributed much to our understanding of the behavior and lives of various shark species, was honored after her 2015 death at age 92 with the naming of a newly identified deep-sea shark: *Squalus clarkae*.

Eleven UMD faculty received Early Career Development (CAREER) awards from the National Science Foundation: **ABHINAV BHATELE** (Computer Science, UMD Institute for Advanced Computer Science, or UMIACS); **SHELBY BENSI** (Civil and Environmental Engineering); **GREGG DUNCAN** (Biengineering); **KATRINA GROTH** (Mechanical Engineering); **YU GU** (Mathematics); **ALICIA KOLLÁR** (Physics); **AMANDA LAZAR** (Information Studies); **KATHARINA MAISELL** (Bioengineering); **PRATYUSH TIWARY** (Chemistry and Biochemistry); **TAYLOR WOEHL** (Chemical and Biomolecular Engineering); and **CHEN ZHANG** (Chemical and Biomolecular Engineering).

Robert E. Fischell Institute for Biomedical Devices Director and Fischell Department of Bioengineering Professor **WILLIAM E. BENTLEY** received the 2021 American Institute of Chemical Engineers Society for Biological Engineering Daniel I.C. Wang Award for Excellence in Biochemical Engineering.

The National Academies of Sciences, Engineering and Medicine appointed **WILLIAM BOWERMAN**, professor and chair of the Department of Environmental Science and Technology and vice chair of the Ornithological Council, to serve on the new Standing Committee for the Care and Use of Animals in Research.

English Professor **TITA CHICO** was listed on The Daily Record's "Power 30 Higher Education in the State of Maryland."

DARRELL CLAIBORNE, director of operations at the Robert H. Smith School of Business, was recognized by the National Association for Campus Activities with its highest honor, the 2021 Founders Award.

IRA CHINOY, associate professor in the Philip Merrill College of Journalism, received the 2021 American Journalism Historians Association National Award for Excellence in Teaching. The Association for Education in Journalism and Mass Communication's History Division also named him one of five winners of the Jinx Coleman Broussard Award for Excellence in the Teaching of Media History.

RITA COLWELL, a Distinguished University Professor with an appointment in UMIACS, was the 2020 recipient of the William Bowie Medal from the American Geophysical Union.

TAMÁS DARVAS, assistant professor of mathematics, was awarded a 2021 Sloan Research Fellowship. Granted by the Alfred P. Sloan Foundation, the award identifies 128 early-career scientists based on their potential to contribute fundamentally significant research to a wider academic community.

Mechanical engineering professor **SIDDHARTHA DAS** was chosen as an Institute of Physics fellow.

ANDRES "ANDY" DE LOS REYES, psychology professor, earned a 2021 Presidential Citation from the American Psychological Association.

Five UMD faculty were chosen as fellows by the American Association for the Advancement of Science, the world's largest general scientific society and publisher of journals such as *Science*: **CHARLES DELWICHE** (Biological Sciences); **GEORGE HELZ** (Geology and Geography); **WILLIAM LAU** (Atmospheric and Hydrospheric Sciences); **COLIN PHILLIPS** (Linguistics and Language Science); and **WILLIAM REGLI** (Information, Computing and Communication).

Entomology Professor Emeritus **GALEN DIVELY** received the Entomological Society of America's

Computer Science Innovator Elected Fellow of National Academy of Inventors

A UMD COMPUTER scientist was elected fellow by the National Academy of Inventors, joining the ranks of some of the nation's most prestigious and creative academic inventors.

Ming Lin, a Distinguished University Professor of computer science with joint appointments in the University of Maryland Institute for Advanced Computer Studies and the Department of Electrical and Computer Engineering, focuses on multimodal interaction, physically based animations and simulations, and algorithmic robotics and their use in physical and virtual environments.

Her work has extensive applications in medical simulations, cancer screening and urban computing, as well as supporting city-scale planning, human-centric computing, intelligent transportation and traffic management. Lin has authored or co-authored more than 300 refereed publications, five books and 18 book chapters. She is among the top 20 most-cited women in computer science and electronics in the world, according to Guide2Research.—**AR**

STAMP IMAGE COURTESY OF U.S. POSTAL SERVICE

ILLUSTRATED PORTRAIT BY VALERIE MORGAN

Plant-Insect Ecosystems Lifetime Achievement Award.

■ For an unprecedented third time, **TOBY EGAN**, associate professor in the School of Public Policy and Robert H. Smith School of Business, was awarded the Richard A. Swanson Research Excellence Award, given to the author(s) of the outstanding refereed research article in each annual volume of *Human Resource Development Quarterly*. Additionally, Egan and co-authors were awarded the Cutting Edge Award, given to outstanding scholarly research published and presented at the 2021 Academy of Human Resource Development Conference.

■ **WEDAD ELMAGHRABY**, professor of operations management and management science, was awarded the 2021 Distinguished Service Award by the Manufacturing and Service Operations Management Society.

■ Higher education Professor **SHARON FRIES-BRITT** was recognized with the 2021 Social Justice in Education Award from the American Educational Research Association.

■ **MARYL B. GENSHEIMER**, associate professor of Roman art and archaeology and director of undergraduate studies in the Department of Art History and Archaeology, won the Council of Graduate Schools' 2020 Gustave O. Arlt Award in the Humanities for her book, "Decoration and Display in Rome's Imperial Thermae: Messages of Power and their Popular Reception at the Baths of Caracalla."

■ **PAUL GOERINGER**, senior faculty specialist with the Department of Agricultural and Resource Economics and an extension legal specialist, was named a director of the American Agricultural Law Association.

■ Mechanical Engineering Professor **ASHWANI GUPTA** was awarded a 2020 Honorary Fellowship from the Royal Aeronautical Society.

■ Minta Martin Professor of Physics **MOHAMMAD HAFEZI** was elected a fellow of the American Physical Society.

■ College of Education researchers **GREGORY R. HANCOCK** and **LAURA STAPLETON** received the American Educational Research Association Division D 2021 Significant Contribution to Educational Measurement and Research Methodology Award as editors for "The Reviewer's Guide to Quantitative Methods in the Social Sciences."

■ **MARCCUS HENDRICKS**, assistant professor in the School of Architecture, Planning and Preservation, was appointed to the U.S. Environmental Protection Agency's Science Advisory Board and Springer Nature's new U.S. Research Advisory Council. He was also listed among 50 trailblazers from across the U.S. honored by The Grist as emerging leaders in climate, sustainability and equity.

■ **LIANGBING HU**, Herbert Rabin Distinguished Professor in the Department of Materials Science and Engineering and director of the Center for Materials Innovation, was elected to the class of 2021 Materials Research Society fellows. His UMD spinoff company, HighT-Tech, won the Spinoff Prize 2021, a Nature Research award supported by Merck KGaA of Darmstadt, Germany.

■ Electrical and Computer Engineering professors **BRUCE JACOB** and **GANG QU** were elected fellows of the Institute of Electrical and Electronics Engineers.

■ Fischell Department of Bioengineering and Minta Martin Professor of Engineering **CHRISTOPHER JEWELL** was named an Australian laureate for 2021. He was appointed as the Miegunyah Distinguished Visiting Fellow at the University of Melbourne and spent the year working on new vaccine technologies. Jewell was also named a fellow of the Biomedical Engineering Society.

■ Professor **CAROL L. KEEFER** in the Department of Animal and Avian Science won the 2022 Pioneer Award of the International Embryo Technology Society.

■ **HANNAH KERNER**, assistant research professor in the Department of Geographical Sciences and NASA Harvest's U.S. Domestic Lead and Machine Learning expert, was named to the 2021 *Forbes* 30 Under 30 List in the Science category.

■ Professor **ALIREZA KHALIGH** in the Department of Electrical and Computer Engineering and the Institute for Systems Research won the Nagamori Award from the Nagamori Foundation in the fields of power electronics and electric machines. He was honored for his pioneering research and development on design and control of high-efficiency and high-power-density electric-motor-integrated wide bandgap power electronics.

■ **MATTHEW KIRSCHENBAUM**, professor of English and digital studies, was appointed chair of the board of directors of the Society for the History of Authorship, Reading, and Publishing (SHARP).

■ Behavioral and community health Professor **CHERYL KNOTT** was named editor-in-chief of the journal *Translational Behavioral Medicine*.

■ Assistant Professor of finance **SERHIY KOZAK** won the Fama-DFA Prize for the best paper published in the *Journal of Financial Economics* in the areas of capital markets and asset pricing.

■ Aerospace engineering Associate Professor **STUART LAURENCE** was elected to the grade of Associate Fellow-Class of 2022 in the American Institute of Aeronautics and Astronautics.

■ **DAVE LEVIN**, an assistant professor of computer science and core faculty member in the Maryland Cybersecurity Center, was selected to join 23 other scientists and policy experts serving on the Forum on Cyber Resilience, managed by the National Academies of Sciences, Engineering and Medicine.

■ Electrical and computer engineering Professor **K.J. RAY LIU** was named a 2021 Distinguished Alumni of National Taiwan University by its Alumni Selection Committee.

■ Associate Professor of urban studies and planning **WILLOW LUNG-AMAM** was appointed to the Social Science Advisory Board at the Poverty & Race Research Action Council.

■ **LINDSEY MAY**, assistant clinical professor and assistant director of the architecture program, won a 2021 League Prize from the Architectural League's Prize for Young Architects + Designers contest.

■ **DAVID MUSSINGTON**, professor of the practice and director of the Center for Public Policy and Private Enterprise in the School of Public Policy, was elected a life member of the Council on Foreign Relations. He also joined the Cybersecurity and

Faculty Q+A

MEREDITH GORE

Conservation Crime Fighter

Geographical Sciences Researcher Shapes New Way to Understand Offenses Against the Earth

WHILE A CRIMINOLOGIST might analyze broad patterns of carjackings or corporate crime, a new, related research field pioneered by a UMD scientist has her tracking the fate of a sluglike animal swimming off Mexico's coast.

Meredith Gore, an associate professor of geographical sciences who in 2009 created the concept of "conservation criminology," worked last summer on the Yucatan Peninsula for one of her latest studies, spurred by concerned local fishing communities and funded by the U.S. Fish and Wildlife Service, to understand the illegal harvesting of sea cucumbers.

Here, she explains her global work, drawing on sociology, biology, anthropology and other disciplines to stop crimes, from poaching to illegal mining, that target the natural world.**–CC**

What are some specific environmental crimes you aim to solve?
It's not so much crime solving—I'm interested in crime prevention instead of crime response. When it comes to conservation, once the tree is cut, it's dead. Once the elephant is shot, it's gone. Once the sea cucumber is illegally fished, you can't turn that around. We're trying to reduce the opportunities that enable crime in the first place.

How have you done that?
I recently worked with colleagues on wild meat trafficking in Kinshasa, a megacity in the Democratic Republic of Congo. We adapted a data collection strategy born in Cincinnati and Las Vegas for analyzing homicide and applied it to this problem. It led us to think about places related to crime, including where potential offenders are found when they're not offending—like churches and soccer stadiums. Now you know where to create an intervention, not necessarily through law enforcement, but perhaps by community organizers or religious personnel.

Why are people committing crimes like poaching or trafficking wild animals?
Sometimes it's a food security issue. Sometimes it's a job opportunity. Sometimes people do it for religious reasons, like a life-cycle ritual. They may not even be aware what they're doing is illegal. I'm using science to help understand what drives all this behavior.

Where have you worked around the world?
Right now I have active projects in Vietnam, Madagascar, Ethiopia, the Congo and Mexico. I'm working with 23 colleges and tribal colleges around the U.S. I'm all over the place, and just trying to think as broadly as I can, and to help people think differently about these problems.

What have you uncovered with that method?
Some of my recent research looks at the role of women. It's women who do most of the work in certain parts of the world—like illegally entering a protected area to collect firewood. Women might be disproportionately arrested as a result. No one is really doing work in this space, which is astounding, because we're half the world's population, so we're half of the problem, and half of the solution.

PHOTO COURTESY OF MEREDITH GORE

Infrastructure Security Agency as executive assistant director of the Infrastructure Security Division.

CHRISTOPHER MONROE, College Park Professor of Physics and a fellow of the Joint Quantum Institute, was elected a fellow of the Optical Society.

AMY J. NELSON, research associate at the Center for International and Security Studies at Maryland, was appointed a Brookings Institution Rubenstein Fellow.

MARGARET PALMER, entomology professor and director of the National Socio-Environmental Synthesis Center, received the Helmholtz International Fellowship Award for Excellent Researchers.

BRUNO PELLEGRINO, assistant professor in the Robert H. Smith School of Business, won the 2021 Charles River Associates Award for the best paper on corporate finance.

YIPING QI, associate professor in plant science, and **DENNIS VANENGELSDORP**, associate professor in the Department of Entomology, made the Web of Science 2020 list of Highly Cited Researchers.

Professor of Information Systems **LOUIQA RASCHID**, who holds a joint appointment in UMIACS, was named a fellow by the Institute for Electrical and Electronics Engineers.

Sociology Professor **RASHAWN RAY** was given the American Sociological Association's Public Understanding of Sociology Award.

Computer science Professor **WILLIAM REGLI** was appointed to the Computing Community Consortium by the Computing Research Association, in consultation with the National Science Foundation.

NAOMI SACHS, assistant professor in plant science and landscape architecture, received the Council of Educators in Landscape Architecture 2021 Excellence in Research Award (Junior Level) and the American Horticultural Society's 2021 Horticultural Therapy Award.

RACHELLE SAMPSON, associate professor of logistics, business and public policy, received the inaugural Panmure House Prize from the Edinburgh Business School at Heriot-Watt University in partnership with FCLTGlobal and funded by Baillie Gifford.

Professor of art **FOON SHAM** received a 2021 Outstanding Educator Award from the International Sculpture Center.

Assistant Professor of English **CECILIA SHELTON** was awarded the 2021 Outstanding Dissertation Award in Technical Communication and the Scientific Communication Award by the Conference on College Composition and Communication for her work surrounding her dissertation, "A Techné of Marginality."

MIROSŁAW J. SKIBNIEWSKI, professor of construction engineering and project management in the Department of Civil and Environmental Engineering, was elected to the National Academy of Construction.

ERICH SOMMERFELDT, an associate professor in the Department of Communication, was selected by the National Academy of Sciences, Engineering, and Medicine for a 2021 Jefferson Science Fellowship in Washington, D.C. He worked with the U.S. Department of State to provide expertise in policy decisions for U.S. public diplomacy around the globe.

ARAVIND SRINIVASAN, a Distinguished University Professor of computer science, was selected to receive a 2021 Distinguished Career Award from the Washington Academy of Sciences.

Physicist Involved in Discovery of Gravitational Waves Elected to NAS

RESEARCH PROFESSOR Alessandra Buonanno of the UMD Department of Physics and director of the Astrophysical and Cosmological Relativity Department at the Max Planck Institute for Gravitational Physics in Germany was elected to the National Academy of Sciences.

She is a principal investigator of the LIGO Scientific Collaboration, which first detected gravitational waves in 2015, a century after Albert Einstein's general theory of relativity predicted them, and her waveform modeling of cosmological events has been crucial in the experiment's many successes.

Buonanno, along with fellow Department of Physics colleagues Professor Emeritus Charlie Misner, Professor Peter Shawhan and others, detailed UMD's contributions to gravitational waves in a 2016 forum.

Earlier in 2021, she was awarded the Galileo Galilei Medal of the National Institute for Nuclear Physics and was also elected to the German National Academy of Sciences Leopoldina.**–CC**

Journalism Professor **LINDA STEINER** was named a member of the International Communication Association Fellows Class of 2021.

LAURA STAPLETON, interim dean of the College of Education, was appointed to the Blueprint for Maryland's Future Accountability and Implementation Board, which plans to close student achievement gaps and transform the state's education system over the next decade.

JENNIFER STURGE, adjunct professor in the College of Information Studies, was inaugurated into the *Library Journal*'s Movers and Shakers class of 2021.

PETER SUNDERLAND, professor of fire protection engineering, was among 32 individuals honored for their outstanding contributions to the field of combustion by the Combustion Institute, naming him among its 2021 class of fellows.

Philip Merrill College of Journalism Lecturer and photojournalist **BETHANY SWAIN** received an Award of Excellence from the Broadcast Education Association in the 2021 Faculty Festival of Media Arts Promotional Video category for her video, "Feed Anne Arundel: 'This Problem Isn't Going Away.'"

STEPHEN THOMAS, professor of health policy and management and director of the Maryland Center for Health Equity, was recognized by the Maryland Public Health Association for his "Shots at the Shop" COVID-19 vaccine initiative.

CHUNSHENG WANG, chemical engineering professor and director of the Center for Research in Extreme Batteries, won the 2021 Battery Division Research Award offered by the Electrochemical Society.

English Professor **JOSHUA WEINER** was on the team that translated "Anniversary Snow" by Yang Lian from Chinese to English and won the inaugural Sarah Maguire Prize for Poetry in Translation. The award is named for a champion of international poetry who died in 2017.

Distinguished University Professor **RUTH ENID ZAMBRANA** in the Harriet Tubman Department of Women, Gender, and Sexuality Studies, received the 2021 Lyndon Haviland Public Health Mentoring Award from the American Public Health Association.

Professor Specializing in Slavery, Resistance Named Carnegie Fellow

UNIVERSITY OF MARYLAND Professor of History Richard Bell, an expert of early American history and slavery, abolition and resistance, was named a 2021 Andrew Carnegie Fellow by the Carnegie Corporation of New York. He was among 26 new fellows awarded $200,000 each by the philanthropic organization to fund significant research and writing in the social sciences and humanities that address important, enduring issues confronting society.

Bell's stipend will support research for his book, "The First Freedom Riders: Streetcars and Street Fights in Jim Crow New York," which will tell the story of mid-19th-century Black New Yorkers who campaigned to desegregate public transit with pioneering civil disobedience strategies.

"I'm over the moon to have the resources to pursue my work on this aspect of the freedom struggle in America for the next few years," Bell says.

Bell, who also recently received a National Endowment of the Humanities Public Scholar award, has held major research fellowships at Cambridge, Yale and the Library of Congress. He serves as a trustee of the Maryland Center for History and Culture and as a founding member of the University of Maryland's chapter of the Universities Studying Slavery consortium.

His most recent book, "Stolen: Five Free Boys Kidnapped Into Slavery and Their Astonishing Odyssey Home," was a finalist for the 2020 George Washington Prize and the 2020 Harriet Tubman Prize. "Stolen" shines a glaring spotlight on the Reverse Underground Railroad, a criminal network of human traffickers who stole away thousands of legally free people of color from their families in order to fuel slavery's rapid expansion.**—JW**

ILLUSTRATED PORTRAITS BY VALERIE MORGAN

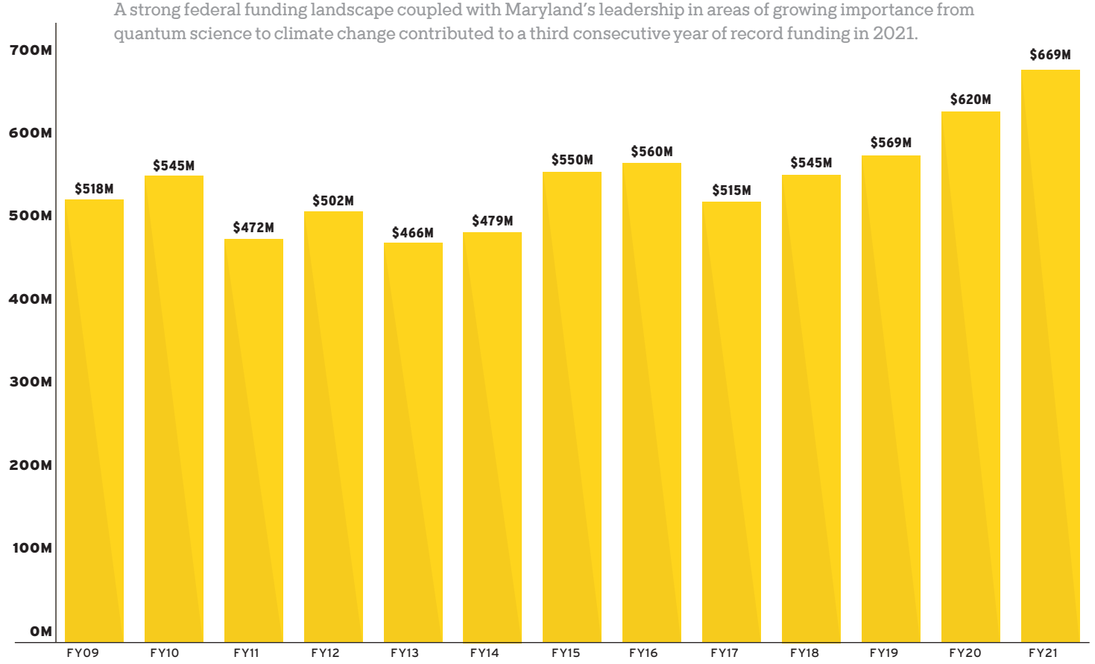
$1.1 BILLION

University of Maryland (**College Park** and **Baltimore** campuses) joint research and development spending ranked **10th** among public U.S. research universities and **16th** among all U.S. universities.*

*SOURCE: 2021 NATIONAL SCIENCE FOUNDATION HIGHER EDUCATION RESEARCH AND DEVELOPMENT (HERD) SURVEY

Continued Growth in UMD's External Awards

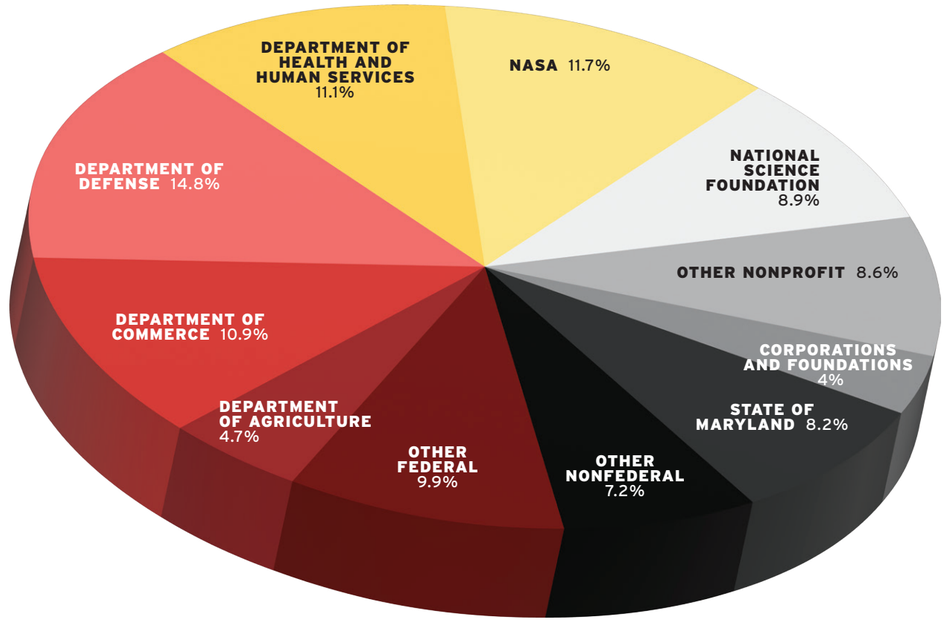
A strong federal funding landscape coupled with Maryland's leadership in areas of growing importance from quantum science to climate change contributed to a third consecutive year of record funding in 2021.



SOURCE (BOTH CHARTS): UMD OFFICE OF RESEARCH ADMINISTRATION

Diverse Funding Sources

From federal agencies responsible for national security and health to a broad range of non-profits and foundations, strong relationships across major sponsor categories enable the University of Maryland, College Park's dynamic research enterprise.



Rising Rankings

20th
public research institution, according to *U.S. News & World Report*

56th
in Jiao Tong University's Academic Ranking of World Universities

14th
among *Forbes'* Top Public Colleges

15th
among U.S. public institutions ranked as Best Global Schools by *U.S. News & World Report*

10th
in *Kiplinger's Personal Finance* magazine's 100 Best Values in Public Colleges for in-state students

10th
overall and
4th
among public universities for undergraduate entrepreneurship, according to *The Princeton Review/Entrepreneurship* magazine

Student Success

46
major national and international awards

- **15** National Science Foundation Graduate Fellowships
- **8** Critical Language Scholarships
- **6** Hollings NOAA Scholarships for study of environmental science and policy
- **4** Fulbright grants for international exchange
- **3** Gilman Scholarships for study abroad
- **3** Goldwater Scholarships honoring STEM excellence
- **2** Ford Predoctoral Fellowships
- **2** Pickering/Rangel/Public Policy and International Affairs program foreign policy scholarships
- **1** Carnegie Scholarship for postgraduate study
- **1** Churchill Scholarship for study at the University of Cambridge
- **1** Gates-Cambridge Scholarship for study at the University of Cambridge
- **1** Marshall Scholarship for study in the United Kingdom

PHOTO BY JOHN T. CONSOLI

Listening to Space-time

In his custom-built lab sequestered in a corner of the University of Maryland Golf Course, the late physics Professor Emeritus Joseph Weber, shown in 1989, chased the faint reverberations from deep space known as gravitational waves. He used giant, sensor-studded aluminum cylinders designed to detect these ripples Albert Einstein had predicted in the fabric of the universe. Few believe Weber succeeded—he disagreed—but as the first scientist to seek gravitational waves, he's regarded as one of the fathers of the LIGO (Laser Interferometer Gravitational-Wave Observatory) Project, which won the 2017 Nobel Prize in physics for detecting them.