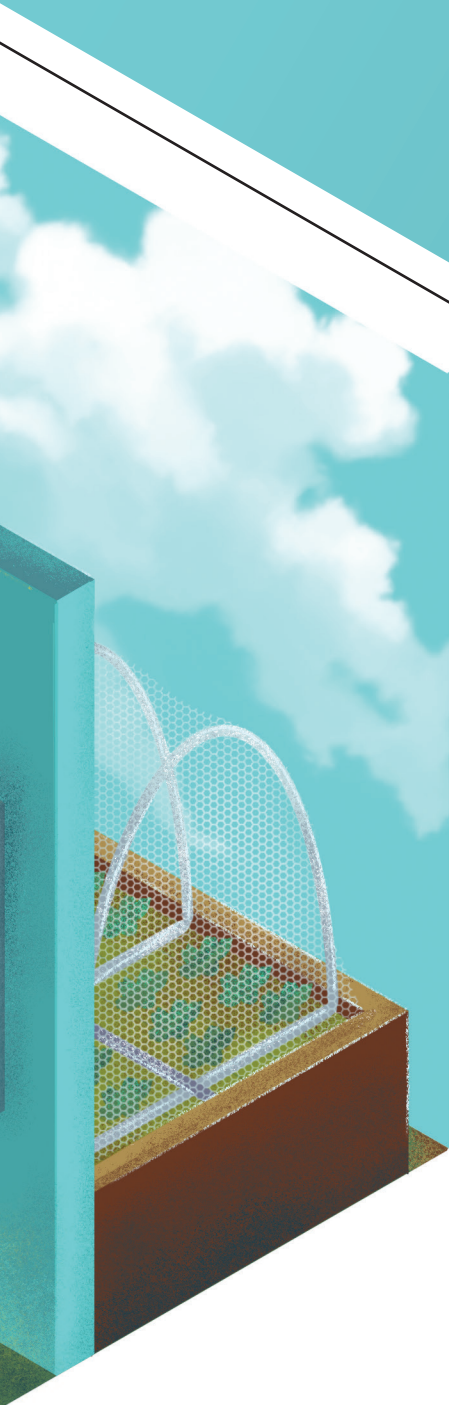


FREDDIE PAGANI



Toni Feder is a senior editor at PHYSICS TODAY.

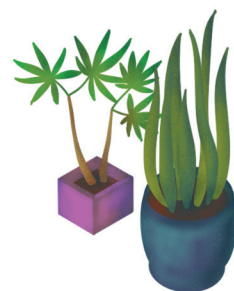
An illustration on the left side of the page shows a fountain with water spraying upwards. The fountain's base is a brown rectangular structure. The water jets are white and form a grid-like pattern. The background of the illustration is a bright blue sky with white clouds.

The promises and perils of a mid-career pivot

Toni Feder

Astrophysics to physical oceanography. String theory to machine learning. High energy theory to biophysics. Such leaps in research focus can be challenging—and rewarding.

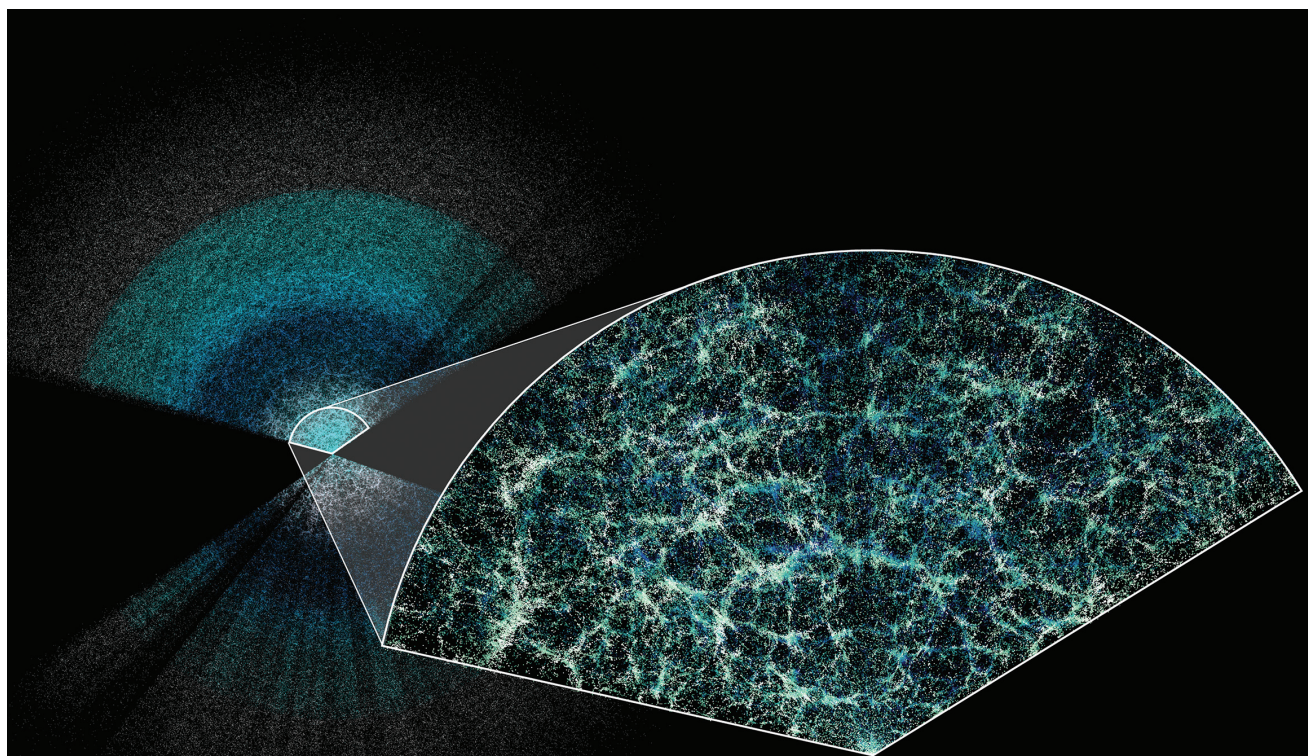
Scouting for a new research area, Larry Abbott, who had made his name as a theoretical particle physicist, says it was “love at first sight” when he heard neurons pulsating on an audio monitor. Alexie Leauthaud was forced to evacuate her home in the Santa Cruz Mountains during a 2020 wildfire. That experience, plus a comprehension of the scale of climate change–induced migration, prompted her to expand beyond her research on dark energy and dark matter into ways to adapt to the warming planet. Nabil Iqbal became interested in applying his skills to real-world problems after volunteering on a COVID-19 task force for the Bangladeshi government. The string theorist is now testing the waters in machine learning.



For established academic researchers, changing focus is often tricky. They have built up a knowledge base and reputation, won grants, assembled equipment, hired students, and formed networks of colleagues. Structurally, universities and funding agencies often pose barriers to working in a new area. And a switch has elements of starting over—described

by those who have done it as simultaneously scary and exhilarating.

More people should switch fields, says Abbott, who is now a theoretical neuroscientist at Columbia University. “Tenure gives you the security to stick your neck out. Moving into a new field is exciting. It rejuvenates your research.”



WHAT DO COSMOLOGY AND GARDENING HAVE IN COMMON? Alexie Leauthaud, an associate professor at the University of California, Santa Cruz, does research in both. She is a spokesperson for the Dark Energy Spectroscopic Instrument, which made the largest-yet 3D map of the universe, a slice of which is shown here. (Courtesy of Claire Lamman/DESI collaboration; custom color-map package by cmastro.)

Finding a mentor in the new field and accessing funding to branch out are two keys to successfully switching—or expanding—one’s research area. Some scientists find both on their own. And in 2022, the Simons Foundation launched the Pivot Fellowship to encourage such research switches across STEM fields. “We want to facilitate conversations that wouldn’t happen otherwise,” says Alyssa Picchini Schaffer, who designed and coordinates the fellowship program.

Old school

In the mid 1980s, Abbott was at Brandeis University and, like other particle physicists, “waiting for the Higgs particle.” Realizing that it would be a “long time before new data came

in,” he went searching for topics to pursue in condensed-matter physics, when he happened to visit Eve Marder in her neuroscience laboratory. They began talking regularly, and eventually Abbott made a suggestion related to her research. “She came back the next week and said, ‘You were wrong,’” recalls Abbott. The quick turnaround time of the experiment for testing his hypothesis convinced him that he “was doing the right thing in switching to neuroscience.”

Still, says Abbott, “I was terrified. I was ignorant of the field. Nobody knew me. I had no grants, no students.” But he had help from Marder: She mentored him, and publishing with her lent Abbott legitimacy in his new field. “Neuroscientists welcomed me,” he says. As a particle physicist, Abbott had been funded by the US Department of Energy. “I told them what I was doing,” he says. “I would say they looked the other way until I got my own grant in neuroscience.”

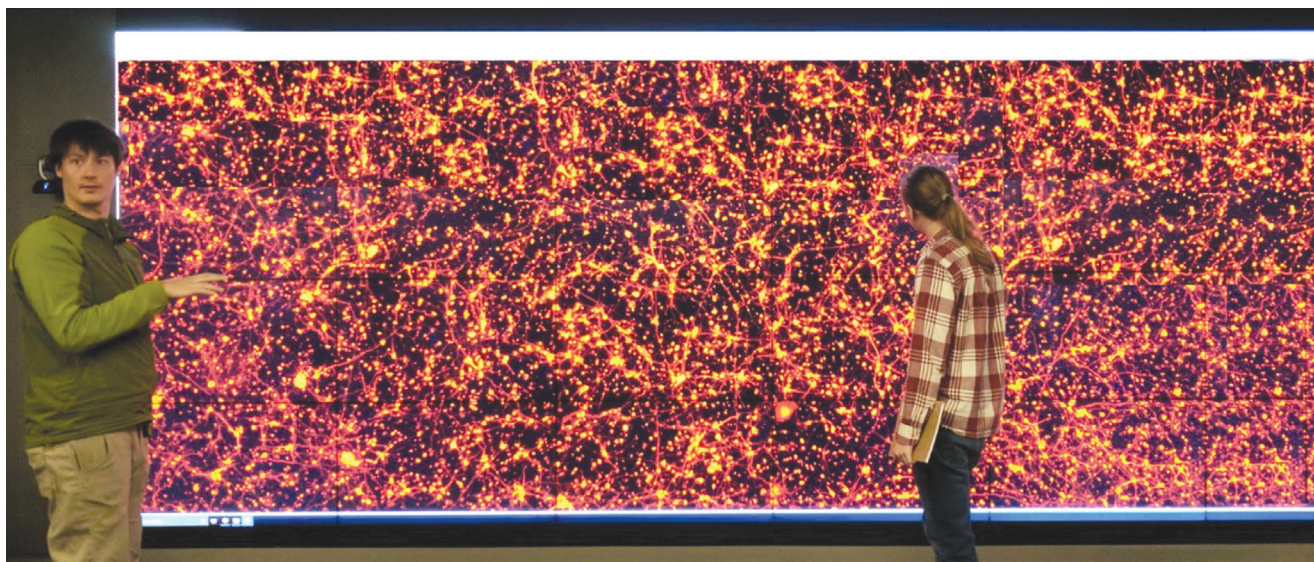
FOOD SUSTAINABILITY, rainwater capture, and composting are among the directions that Alexie Leauthaud is pursuing as she expands her research to focus on adaptation to climate change. The images show the campus site of her experiments, which include studying how to optimally irrigate lettuce with rainwater. (Courtesy of Alexie Leauthaud.)



Seeing physics in everything

Retinal implants, a sports sensor, and AI methods to distinguish between authentic and fake Jackson Pollock paintings are among the projects that Richard Taylor, head of the physics department at the University of Oregon, is currently working on. Shown below are then-graduate students Julian Smith (left) and Conor Rowland (right), quantifying the fractal character of retinal neurons to replicate the fractality in a bionic eye.

Taylor branched out from low-temperature nanoelectronics after earning tenure. “I don’t know what the tolerance of my physics colleagues and my institution to my research transitions would have been if they hadn’t worked,” he says. Switching, he adds, requires building a new team and finding new collaborators. When students see someone pivot, he says, it sends a message that they can use physics in many broad ways in their future careers. His advice is to “follow your interests.” (Photos courtesy of Richard Taylor.)



I never went a day without funding, even though I was switching fields.”

Geoffrey West is a high-energy theorist who, after a long career at Los Alamos National Laboratory, began exploring other fields and then was lured to the Santa Fe Institute. It was the early 1990s, and West was taking stock of his life and career. “I come from a family of short-lived males,” he says. “I was in my mid 50s and was preparing that I had 10 years to live, maximally. That, coupled with the cancellation of the Superconducting Super Collider, made me focus on biology: What leads to aging and mortality?”

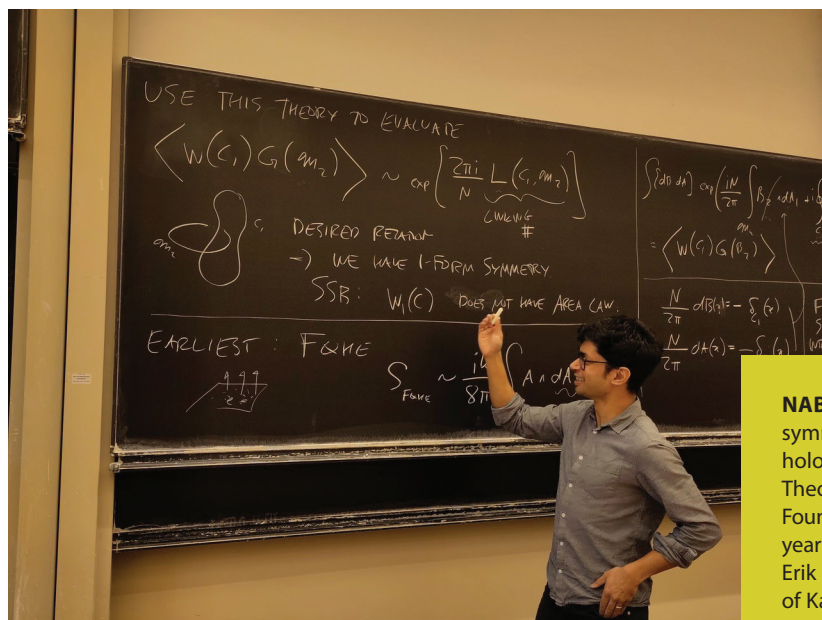
West connected with biologist James Brown. Together, they made advances in the studies of life expectancy, sleep, cancer, city sustainability, and more. West describes his con-

tributions as being “very much from a physics viewpoint.” His early work in biology was done “with funding not intended for it.” But his results turned out to be high profile, and soon an art collector approached him at a public lecture and offered to fund his research.

“One of the curious things that I didn’t realize was the difference in cultures between biology and physics,” says West. “Biology can be very qualitative. It’s not very precise. It was a language problem. I spent a huge amount of time trying to boil down complicated math into something simple.”

Expanding horizons

“When a field gets too crowded, it’s time to get out. I get claustrophobic,” says Mark Raizen, an experimental physi-



NABIL IQBAL lectures on generalized global symmetries at a school on quantum field theory and holography held last February at the Institute for Theoretical Physics in Jena, Germany. A Simons Foundation Pivot fellow, Iqbal is spending this academic year exploring machine learning with his Pivot mentor Erik Bekkers at the University of Amsterdam. (Courtesy of Katharina Wölfl.)

cist at the University of Texas at Austin. “If I start to feel like I am hearing the same talks over and over again, it gets boring.” Around 2001, after more than a decade working on cold optical lattices, he made a “conscious decision” to stop. The decision was difficult, he says, because he had “inertia, funding, reputation, and knew the people in the field.”

Raizen pivoted to soft condensed matter and short-time Brownian motion, and more recently, he has focused on the production and application of isotopes to medicine (see *PHYSICS TODAY*, May 2024, page 24). Unrestricted money tied to his endowed chair gave him the means to try new things. In addition, he says, his university was supportive and provided internal funds. “We didn’t require any expensive new equipment. That would be a barrier.”

The safe way to switch research areas, says Raizen, is to phase things out slowly while adding a new area. That can be hard, he adds, because by the time someone dives into a new field, they are often less engaged in the established one. “When I recruit students, if I’m not excited, then it’s not motivating for them.”

Leauthaud, an associate professor at the University of California, Santa Cruz, has added climate change adaptation to her research portfolio. She is not bored with cosmology—she recently took on the role of spokesperson for the Dark Energy Spectroscopic Instrument (see *PHYSICS TODAY*, October 2016, page 28). But she realized that “climate change is a serious threat to the academic endeavor itself” and decided she wanted to “work on solutions, education, and preparation.”

Her first move, in 2021, was to teach a class for nonphysics majors on the reports of the Intergovernmental Panel on Climate Change (IPCC). Next, she applied for small research

grants, mostly for work on growing food more sustainably.

To some extent, says Leauthaud, the direction of her climate-related work is “hodgepodge. It depends on what grant opportunities I see.” Recently, for example, she and colleagues on campus got money to work on harvesting rainwater and composting.

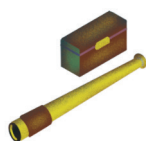
Leauthaud partnered with professors in her university’s education and environmental studies departments to create projects that connect college students with the local community through experimenting with urban food production. She is splitting her time about 75-25 between astrophysics and climate change adaptation. In the long term, though, she plans to shift more into studying climate change. “I would do modeling for solutions. The food system is broken, and modeling could benefit policymaking. I’m reading the science and trying to foresee the problems that will face us in 10 years.”

“I tell my students that the problem is so big, there is no single solution,” says Leauthaud. “Pick something that interests you and work on that, even if it seems small and even if only part-time.”

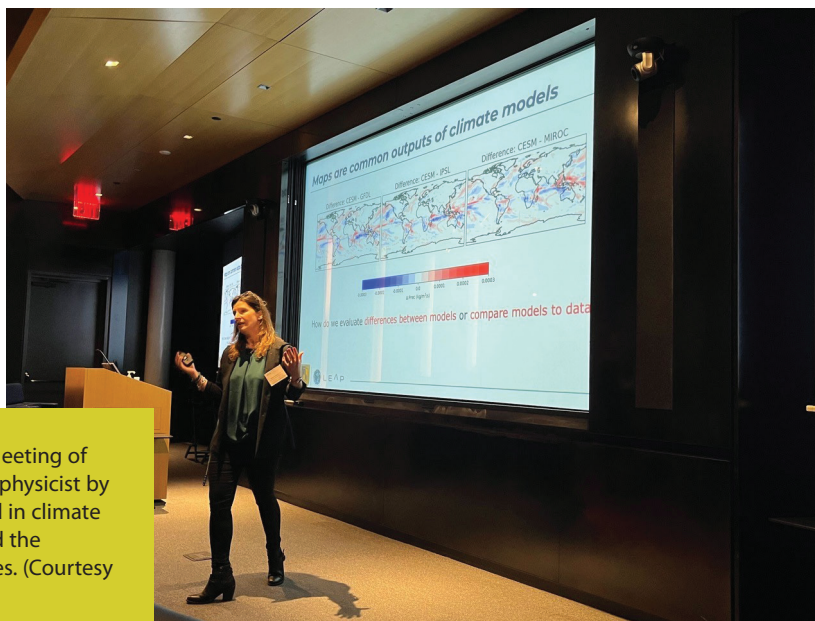
Money for change

The Simons Foundation created its Pivot Fellowship to make it easier for researchers to explore new fields. Awardees must demonstrate success in a quantitative field and use their fellowship to explore a different field. Part of the aim is to cross-pollinate and support interdisciplinary research, says Picchini Schaffer.

Pivot fellows spend a year working with a mentor. The fellowship pays each recipient their salary, plus \$10 000 for



VIVIANA ACQUAVIVA presented her work at a meeting of Pivot fellows and their mentors last April. An astrophysicist by training, she spent her fellowship getting involved in climate change modeling. The Simons Foundation created the fellowship to stimulate cross talk among disciplines. (Courtesy of Pierre Gentine/LEAP.)



travel and other incidentals, and gives their mentor \$50 000 for research costs. After the year in training, Pivot fellows are invited to apply to the Simons Foundation for research awards in their new field for up to \$1.5 million over five years.

Iqbal, a professor of mathematical and theoretical physics at Durham University in the UK, is one of this year's seven Pivot fellows. He had been trying to get into machine learning, but, he says, his heavy teaching load made it "hard to find time to learn something new." The fellowship gives him a break from teaching and the opportunity to delve into "a problem in deep learning that involves geometry." He is spending this academic year at the University of Amsterdam with his Pivot mentor, Erik Bekkers.

Most of Iqbal's work has been in quantum field theory and string theory. Machine learning is much more applied, he says. "You can run feedback loops, and if you have an idea to make something work better, you can test it." At this point, he says, he's not sure what he'll do after his fellowship. "I love my current field, so it's hard to say if I'd leave it completely. I'll have to see where I can be productive."

Viviana Acquaviva describes herself as an astrophysicist, a data scientist, and "a climate scientist in training." Last year, as an inaugural Pivot fellow, she took a leave from her home base at the New York City College of Technology to dive into climate science at Columbia University's LEAP (Learning the Earth with Artificial Intelligence and Physics) lab.

Acquaviva says she has "always jumped around in astrophysics quite a bit." About a decade ago, she made a "radical shift into machine learning." And a couple of years ago, she was looking for a "new source of juice." That's

when she happened on the LEAP lab and thought, "I am a physicist, I know some AI, and I'd like to learn about Earth sciences."

Acquaviva is applying her data and simulation skills from astrophysics to issues related to climate change. One project involves developing metrics to evaluate climate models, and another looks at the role of the ocean in the global carbon cycle. "Ideally, we'd like to see our work become part of the models that go to the IPCC and then to governments."

The Pivot fellowship has been great, says Acquaviva. "It's hard to do something new. Good mentors will help you succeed and introduce you to a new network of people." Picchini Schaffer notes that many outcomes from the Pivot fellowships are possible. "One is that a fellow learns something else and brings it back to their original field. That's not a pivot, but it's still positive." She anticipates that 7–10 new fellows will be chosen each year.

Academic silos

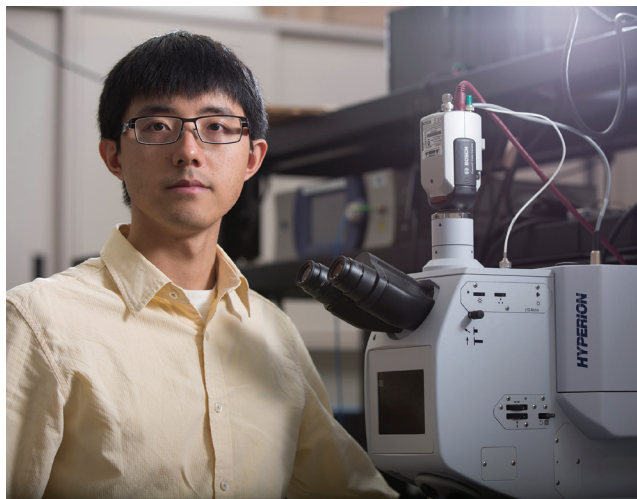
Shifting research focus often involves cross-disciplinary collaboration. Although the academic enterprise has praised such efforts for decades, university research remains fairly compartmentalized. "Look at how people are hired," says Leauthaud. "The incentive is to ultraspecialize. It's ultrasiloed. In academia, we are overwhelmed with the things we are asked to do. There is no incentive to get a bigger picture, and as a professor, you really don't have time."

And switching research areas can be risky for faculty members. "You may not fit into any department. You may not get promotions," says Leauthaud. People who pivot can take a hit to their careers, says Raizen. "You will not be cited as much,

Taking flight into biophotonics

A butterfly's wing color can be important for responding to light and heat, finding a mate, evading prey, and more. Nanfang Yu, an associate professor of applied physics at Columbia University, and his students image butterfly wings from UV to IR wavelengths. He is collaborating with biology professor Naomi Pierce, curator of the moth and butterfly collection at the Museum of Comparative Zoology at Harvard University, to learn about the multifunctional structural and optical features of their wings.

For Yu, the project combines his expertise in nanophotonics and his lifelong interest in nature. He credits encouragement from his department and funding from the Gordon and Betty Moore Foundation for the freedom to follow his broad interests; his research is roughly three-quarters nanophotonics and one-quarter biophotonics. (Image of Yu courtesy of Jane Nisselson; butterfly image courtesy of Nanfang Yu and Cheng-Chia Tsai.)



you lose momentum. The built-in incentive is to not pivot.”

Establishing credentials in a new field is a challenge, says Mark Bowick, deputy director of the Kavli Institute for Theoretical Physics at the University of California, Santa Barbara. Even before he got tenure, he worked in both string theory and soft-matter theory. “Often, people trained in one field don’t know much about other fields and tend to undervalue them,” he says. In recent years, Bowick’s focus has been on active matter. Early in the pivot process, he adds, it’s easy for people in your new field to think you are a dilettante. “You don’t get invited to talks. You are like a beginning graduate

student.” In the meantime, he says, colleagues in your old field think you are “washed up.”

Despite the challenges, researchers who have pivoted say it’s worth it. “I have found it very energizing,” says Brandeis University’s Albion Lawrence, who as an inaugural Pivot fellow expanded his research from string theory to physical oceanography. “I come from a nonempirical field and wanted to think about data,” he says. “I’m having more fun now.” Lawrence describes his intellectual heritage as thinking about physics broadly. “It never seemed insane to me to go work on something else.”

PT