

Trade wars and other geopolitical tensions strain US–China scientific collaborations

Researchers are increasingly on edge about collaborations that until recently were encouraged.

This summer a tenured physics professor at a Texas university received a letter from his employer expressing concern about the professor's plans to cochair a conference in China. The letter noted that he had not submitted paperwork to request foreign travel, the conference was at a university listed as restricted by the US Department of Commerce, and his fellow cochair was a member of China's "Thousand Talents" foreign recruitment program. The letter cited financial and reputational risks to the university. The physicist—a US citizen who is not of Chinese descent—cochaired the conference anyway; so far, at least, he has not suffered any negative consequences.

Franklin Tao, a chemistry professor at the University of Kansas, was indicted on federal charges in July for allegedly holding a paid position in China that he hadn't disclosed to his US employer or to the US agencies that funded his research. He faces up to 20 years in federal prison and fines of up to \$500,000.

A Chinese physicist who has worked in the US for many years recently waited in limbo for months for a visa to reenter the US. Fearing repercussions, he and the Texas physicist each requested that their identities and universities be concealed; several scientists in both the US and China declined to speak with PHYSICS TODAY for this story.

Such incidents—and many others like them—have cast a chill over scientific collaborations between researchers in the US and China. "There is a bipartisan feeling in Congress that the Chinese are engaging in unscrupulous practices," says physics Nobel laureate David Gross of the University of California, Santa

Barbara; he is president of the American Physical Society (APS) and is a foreign member of the Chinese Academy of Sciences. "The effect is to discourage scientific collaboration and mobility completely."

Denis Simon has studied Chinese science and technology for decades and is executive vice chancellor of Duke Kunshan University, located near Shanghai. "If you are a scientist in the US, irrespective of ethnicity, and you are involved with Chinese counterparts, this is a very difficult time," he says. "I think it's reached its worst point in 40 years."

The Beijing–Washington relationship is "seen now through a national security lens, with deep distrust," says Robert Daly, director of the Wilson Center's Kissinger Institute on China and the United States. "We are in a comprehensive competition for influence across every sphere—trade, military, financial, and the development and marketization of technologies." Science and technology are key to many aspects of dominance—5G, artificial intelligence, synthetic biology, quantum computing. That's why universities are caught in the middle, he says. "How does the US preserve national security and maintain openness without being a complete sucker?"

Security versus openness

In a 16 September letter to the US research community, Kelvin Droegemeier, who heads the White House Office of Science and Technology Policy, wrote, "As researchers, we must acknowledge the changing geopolitical and international scientific landscape: United States policies and practices must evolve thoughtfully and appropriately to meet current



and future challenges." He did not explicitly name China.

Singling out recruitment programs sponsored by foreign governments, Droegemeier said that some have features that are "unacceptable and inconsistent with our research values and research principles." He listed the failure to disclose foreign funding, affiliations, and appointments; diversion of intellectual property (IP) or other legal rights; breaches of contract and confidentiality; unapproved foreign labs; and "surreptitious gaming of the peer-review process."

His missive followed statements along the same lines by the National Institutes of Health in August 2018 and by the Department of Energy in January and NSF in July of this year. DOE and NSF have restricted participation in foreign recruitment programs.

No one doubts that there have been incidents of people secretly pulling in two salaries ("double dipping"), committing industrial espionage, hacking computers, stealing IP, and engaging in other



XIAOXING XI OF TEMPLE UNIVERSITY speaking in June at an event about the current climate for Chinese American researchers. The Temple University condensed-matter physicist was arrested in May 2015 for allegedly sending technological secrets to China. The charges were dropped.

misdeeds. But the scale of the problem is unknown, says Gross. "If you have two bad eggs in the middle of hundreds or thousands, who cares? We [at APS] are trying to inform the agencies of the enormous harm to the US research enterprise if we are no longer attractive to foreign scientists. It won't be just the Chinese. I am very disturbed by living in a country where the actions of my own government make me afraid of collaborating with scientists from abroad."

At the moment murky guidelines lead many US institutions and individual scientists to play it safe. "Regardless of citizenship, people don't want to get into trouble," says Xiaoxing Xi, "so they reduce their interactions with China." A condensed-matter physicist at Temple University, Xi was arrested at his home in May 2015 and charged with sending

restricted technology information to China. The charges were dropped four months later, when it turned out that government prosecutors had misinterpreted their own evidence. But by then his career had suffered—he had not been allowed on campus or permitted to talk to his students, and his university had transferred his grants to other principal investigators. His research group has withered from 15 to 3. Now, he says, "with more Chinese scientists being charged and scrutinized, it makes me feel very unsafe."

Tobin Smith, vice president for policy at the Association of American Universities, points out that the biggest concerns are often ethical, not legal. "We have to find the line that protects us and allows us to maintain openness," he says. "It starts with the federal agencies being

clear about the rules, and the rules should be harmonized across the agencies."

China with perks

The US is a global leader in higher education and research. That preeminence is widely recognized as being due largely to the country's ability to attract top students and scholars from around the world. In a 4 September letter to US agency heads, some 60 professional societies wrote that "scientific progress and U.S. economic development have been vastly accelerated by bringing international minds together and [have] helped to drive innovation and discoveries" in cancer and genetics, gravitational waves, green chemistry, food safety, and other areas. APS and the American Institute of Physics (AIP), which publishes *PHYSICS TODAY*, were among the signatories.

Formal collaborations and student exchanges with China ramped up after a 1979 agreement between the two countries. And for the past few decades, students from China have been among the largest international cohorts in the US. In recent years, non-US citizens have made up roughly half of individuals earning physics PhDs from US institutions, and more than a quarter of them are from China, according to Patrick Mulvey of AIP's Statistical Research Center. Across all fields more than 360 000 students from China were in the US for the 2017–18 academic year, according to the Institute of International Education.

But Chinese students and scholars are finding it increasingly difficult to obtain visas for the US. For example, at least 20 Chinese scientists missed this year's APS March meeting because of visa delays. And visas for Chinese citizens now often require annual renewal instead of being valid for 5 or 10 years, as previously; students in robotics, aviation, and high-tech manufacturing are among those affected. Students from China and some other countries may hesitate to go to the US—and US faculty members may hesitate to take them on—given the uncertainty about staying in the country to complete their programs of study.

"I have a postdoc from China, and he hasn't been home for eight years," says Andrea Liu, a theoretical physicist

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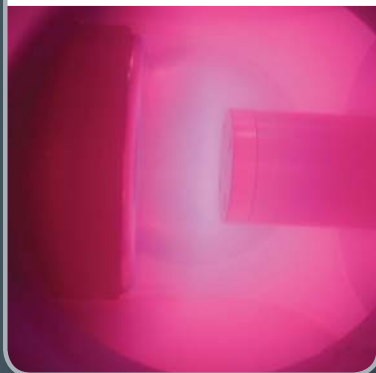
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at the University of Pennsylvania. "We have collaborations with people in France, but he can't go there because he might not get back into the US. It's hurting his career."

Liu sometimes collaborates with a former postdoc who went back to China nearly a decade ago. "He's terrific, and he has amazing computational resources that far exceed what we have here," she says. Robert Ritchie, a materials scientist at the University of California, Berkeley, and at Lawrence Berkeley National Laboratory, agrees that nowadays "China has far more resources in terms of money and equipment than we do in the US. Some of the things I want to do, I can't do here." But in the past year or so, he says, "every-

thing is coming under increased scrutiny. One feels a bit inhibited now in dealing with Chinese groups."

The top Chinese students used to stay in the US after completing their studies, says Ritchie, whose collaborations with scientists in China go back at least 15 years. "That's not true anymore. The situation in China has improved for them, they are attracted back with perks, and they wonder if they can thrive here."

Haiyan Gao, a nuclear physicist at Duke University, notes that Chinese scientists do not lack opportunities to work with researchers in other countries. "If you are counting on their collaboration, and in the end they can't get a visa, the US loses out. We have seen more Chinese



MIGUEL RUIZ GARCIA

ANDREA LIU (right), a physics professor at the University of Pennsylvania, with postdoc Ge Zhang of China and graduate student Sean Ridout of Canada. Zhang hasn't gone home to see his family or traveled to conferences outside the US in several years because of the uncertainties surrounding visas.

colleagues devote more effort to Europe." China has built up its domestic know-how, she says. "To cut things off now is frustrating."

Tightened rules, heightened fears

Reports of increasing threats and pressure from US government agencies have prompted universities, national laboratories, and funding agencies to tighten their practices and more rigorously enforce existing rules. For international business travel, for example, US government employees and subcontractors are required to obtain a country clearance cable from the State Department that includes information intended to be helpful for their trip. In earlier days, says a DOE-funded scientist who requested anonymity, "no one cared, but now they really pay attention, and there have been times when I didn't get my cable until I landed in China." He adds that in a "pre-emptive move" to avoid having to ask approval from DOE, his institution rejected his request to attend a conference and give talks in China next year.

Many funding agencies and universities now discourage US researchers from accepting hospitality from their Chinese hosts. Betty Tsang, a physicist at the National Superconducting Cyclotron Laboratory at Michigan State University, says that in the past, "when I would go for collaborative work or conferences to China, I would pay to get there out of my grants, and the Chinese hosts would pay for my expenses while I was there." By following her lab administration's recent advice to reject such support, she and her students can't afford to go as often, she says. "I'm keeping my existing collaborations, but I'm not initiating new ones." The hassles and uncertainties about what will be allowed are too great, she explains.

Written requirements for hiring Chinese nationals at Los Alamos National Laboratory (LANL) have not changed, notes Alan Hurd, who oversees collaborations between the lab and universities. But after DOE released its January memo, he says, "hiring managers are frequently avoiding Chinese candidates." Even before that, DOE employees felt the crack-down especially keenly. One DOE-funded scientist who was asked by Chinese colleagues to apply for the Thousand Talents program says his institution initially approved his application but later told

him to decline the offer. DOE has traditionally valued international collaborations, the researcher says, but currently "they would rather you stay local. At least I can still exchange emails [with Chinese colleagues] without logging them."

An anonymous Chinese physicist says he has stopped splitting his professional life between the US and China. The same goes for his colleagues, he adds, who are either returning to China or remaining in the US. The arrests, firings, visa delays, and tone from the funding agencies make people nervous. "The gray area is unsafe," he says.

Adding to the anxiety is that the crack-downs are uneven across subfields and campuses. In fusion research, for example, DOE this year renewed a grant for joint work between scientists in the US and China. Houyang Guo, who is based at the DIII-D tokamak, a national user facility in San Diego, California, and coordinates US-China fusion activities for DOE, says he has experienced no problems. Even so, when he traveled to China in May, he took a company loaner laptop for the first time instead of his own, and when he returned he was debriefed both by US Customs and by General Atomics, the company contractor that runs DIII-D for DOE. Both events were firsts for him.

Fu-Chun Zhang, director of the Kavli Institute for Theoretical Sciences in Beijing, says new US restrictions haven't affected his institute, although he did hire a postdoc earlier this year whose offer to go to LANL was rescinded. And Zhang noted lower-than-usual participation by US colleagues at a workshop in China in September 2019 on strongly correlated electronic systems. At least one physicist was denied approval from DOE to attend the workshop, he says. "It will take time to see the real effects of the US clampdown. It's not positive. Scientific exchange is important for both the US and China."

Liu says she is "extremely concerned about what is going on." As an APS board member, she attended an unclassified briefing in February by the FBI and the Office of the Director of National Intelligence requested by APS. The briefing covered the potential risks of academic espionage, intellectual property theft, and other dangers posed by foreign actors, with a focus on China. "My main concern is that the FBI get it right before they

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indict someone,” she says. “With Wen Ho Lee they didn’t understand the science,” she says of the LANL scientist who was arrested and charged with espionage in 1999 (see *PHYSICS TODAY*, July 2006, page 23). “They got the science wrong with Xiaoxing Xi of Temple University.” It ruins a person’s life, Liu says, and it’s bad for science. “It fosters a climate of distrust and racial profiling. As an ethnic Chinese—I’ve never even been to China—it makes me uneasy.”

Full disclosure

Disclosure is crucial, says Rebecca Keiser, who heads NSF’s Office of International Science and Engineering. Double dipping and foreign talent recruitment programs can be a problem because funding agencies need to know that the scientists named on a proposal have the time to do the work they are proposing, she explains. “We have seen an increase of nondisclosure of other support and appointments that pose conflict and overlap.” And some of the foreign contracts contain clauses that conflict with values of research integrity and openness. For example, she says, US researchers have been asked to sign that they won’t tell their home institution they are taking a second position, or that they will provide their Chinese partners with pre-publication information, data, and ideas. “NSF funds basic research,” she adds, “and we want it open, but when it’s ready.”

A few years ago Tsang was offered a position in China that would have let her spend three months there each year. A well-equipped lab and extra manpower would have come with the position, she says. But the fine print said that the Chinese institution would own the copyrights to works, inventions, patents, and other intellectual property she produced during the contract period. “There was no consideration of the contributions from my primary institution, where I would be doing most of the work,” she says. She turned down the offer.

The change in attitude toward China “has been brewing for a while,” says the AAU’s Smith. He attributes the increased wariness to China’s economic rise and its increasingly authoritarian government. And he points to testimony in February 2018 by FBI director Christopher Wray as an “inflection point.” Wray said that China is using university personnel as



SCIENTISTS AT THE DIII-D TOKAMAK headquarters in San Diego, California, remotely conduct plasma physics tests on the Experimental Advanced Superconducting Tokamak, in Hefei, China. The collaboration has not experienced problems due to US–China tensions, and the Department of Energy recently renewed its funding.

“nontraditional collectors of information to take back to China, and universities are naïve to the problem.”

Duke Kunshan University’s Simon says that China has moved from the margins to the mainstream to become a maker as well as a taker of scientific knowledge. The chill in the US research community comes, he says, from several sources: the FBI and intelligence agencies visiting universities, the universities in turn warning their faculty, the funding agencies cracking down, and the overarching trade war. The chill creates a cloud over collaborations, he says. “The irony is that when asymmetry dominated, the cooperation proceeded well, and China was the greater beneficiary. But now the US has more to gain, and the US is concerned China may be eating our lunch.”

With a nod to the Cold War, Simon notes that the trust built between scientific communities has withstood tense times and helped to provide continuity despite difficult political relations. But this time, “scientific knowledge is the essence of the political problems.”

Deep dissatisfaction

A growing number of academic leaders are speaking out for academic freedom. In a 30 August column in the *Washington Post*, “No, I won’t start spying on my foreign-born students,” Columbia Univer-

sity president Lee Bollinger writes that “stewards of major research universities couldn’t contain intellectual freedom even if we wanted to.” He acknowledges that the “unauthorized use of intellectual property by overseas competitors is a serious problem,” but says, “surveillance of foreign-born scholars in this country is the wrong solution.”

In May the Office of Science and Technology Policy formed a committee comprising representatives from science agencies and from security agencies to develop uniform approaches to balancing commercial and national security against open research environments. NSF has requested that JASON, an independent scientific advisory group, conduct an analysis of the risks of espionage and IP theft; the group’s report is expected by the end of the year. And the National Academy of Sciences has begun holding expert roundtables to assess risks and examine possible policy responses.

Still, no balance between security and openness will please everyone, says the Wilson Center’s Daly. Meanwhile, global problems like pandemics and climate change demand global cooperation. “The problem is truly new, and it’s full of paradoxes. How much vigilance can openness endure? How much openness can security tolerate? Any tradeoff will be deeply unsatisfactory.”

Toni Feder