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Tensions between Presidents Xi Jinping and Donald Trump are spilling into research.

ARRESTS OF CHINESE SCIENTISTS MARK NEW FRONT IN US CRACKDOWN

US authorities increase scrutiny of visiting researchers' ties to Chinese military.

By Nidhi Subbaraman

When cancer researcher Juan Tang took refuge from the US Federal Bureau of Investigation (FBI) at the Chinese consulate in San Francisco in July, she drew national attention. Days later, the FBI arrested Tang — a Chinese national who was on a months-long research assignment in the United States — on charges of concealing her role as a Chinese military officer from the US government. Tang has since entered a not-guilty plea and is awaiting a jury trial.

Around the time of her arrest, the US authorities announced the arrests of a handful of other Chinese scientists for allegedly hiding ties they had to China's military on visa applications. Scholars of US–China policy say that the arrests mark a new front in the United States' battle against foreign interference in its universities, in which government officials are increasingly scrutinizing researchers' links to China's People's Liberation Army (PLA).

Scientists with ties to the Chinese military have visited the United States for years, says Brad Farnsworth, vice-president of the American Council on Education in Washington DC — but only now are officials "really looking very carefully at the background of the people who come here, particularly from China". Exactly how the FBI and the US Department of Justice (DoJ) are focusing their investigations remains unclear. The lack of concrete information from US authorities has triggered concerns that some scientists might be unfairly accused of espionage.

Many of the top hospitals in China, for example, are affiliated with the military, says Mary Gallagher, a political scientist at the University of Michigan in Ann Arbor, who studies US–China relations. "And so by default, if you're a doctor at one of those hospitals, you're going to have an affiliation with the Chinese military." That affiliation doesn't automatically mean that if you're collaborating with a US researcher you're engaging in espionage, she says.

"To assume a comprehensive conspiracy is too far from the reality."

The arrests come as tensions escalate between the United States and China. In 2018, US President Donald Trump's administration announced the China Initiative, aimed at stopping China from stealing intellectual property and technologies from US companies and research laboratories.

The US government's recent focus on researchers' links to the PLA has arisen alongside Chinese President Xi Jinping's 'military–civil fusion' strategy, in which university research and corporate intellectual property are being tapped for military use. In May, the Trump administration issued an order that would reject visa applications from researchers and students from some military-linked Chinese institutions, barring those people from entering the United States.

A new chapter

The arrests announced in July all involved accusations of visa fraud, according to officials at the DoJ and the FBI.

Tang had been a visiting researcher at the Department of Radiation Oncology at the University of California, Davis, since January. DoJ officials claim Tang denied serving in the military on her visa application — but that she is a "uniformed officer" in the PLA Air Force, a claim based in part on photographs of her in a military uniform that the DoJ submitted alongside the charges. The agency also claimed that the other researchers whose arrests were announced in July had past or current appointments in the Chinese military that they misrepresented on their visa applications.

The extent to which US research is actually being funnelled to the Chinese military, and how to block it meaningfully and fairly if it is, remain unclear, say experts — as do the parameters the United States is now using to label foreign scientists and collaborations as a threat.

According to court filings, one of the researchers arrested in July was working on military radar technology. But otherwise, the five scientists' fields of research alone — neurobiology, cell biology, medicine, physics, and machine learning — would not raise alarm from a national-security perspective, experts say.

Federal agents have not been transparent about what kind of US–China collaborations they view as risky. Glenn Tiffert, a research fellow at the conservative Hoover Institution, a public-policy think tank at Stanford University in California, suspects that there are many other cases that the government deems problematic from a national-security perspective.

To estimate the scope of the US government's concerns, Tiffert and his colleagues at Hoover released in July an analysis of Chinese- and English-language academic studies from 2013–19 that were listed in a major Chinese science and technology publishing database. The analysis found 254 that were co-authored by at least one scientist from a US university and one from a 'Seven Sons' university in China — seven institutions that were founded by or assisted the military before becoming civilian centres of higher education.

But an analysis by *Nature* using the Dimensions database from London-based Digital Science suggests that links between Chinese and US scientists are more prevalent than the Hoover report indicated. (Digital Science is part of Holtzbrinck, the majority shareholder in *Nature*'s publisher, Springer Nature). The analysis found more than 12,000 publications from 2015 to 2019 that had been co-authored by scientists in the United States and at one of the Seven Sons. Among those, 499 authors had a dual affiliation with a US institution and a Seven Sons university and were listed on papers declaring grant funding from the NIH or the US National Science Foundation.

But separating true threats from ordinary collaborations could be a challenge, some experts say. It has not been unusual for Chinese researchers with appointments in the military to visit the United States and work on non-classified projects, says Denis Simon, senior adviser to the president at Duke University in Durham, North Carolina. Simon led the Duke Kunshan University in China as vice-chancellor until July this year. "To assume a comprehensive conspiracy is too far from the reality," he says.

In general, universities do not have rules that bar scientists with affiliations to the foreign military from working with university researchers. But in the absence of nuanced federal guidelines, institutions might well be forced to take a fresh look at these collaborations.

"There is no longer any status quo to go back to," says Farnsworth.

Additional reporting by RIchard van Noorden.

ASTRONOMERS DETECT 'MINDBOGGLING' BLACK-HOLE COLLISION

Gravitational waves suggest merging black holes fell into 'forbidden' range of masses.

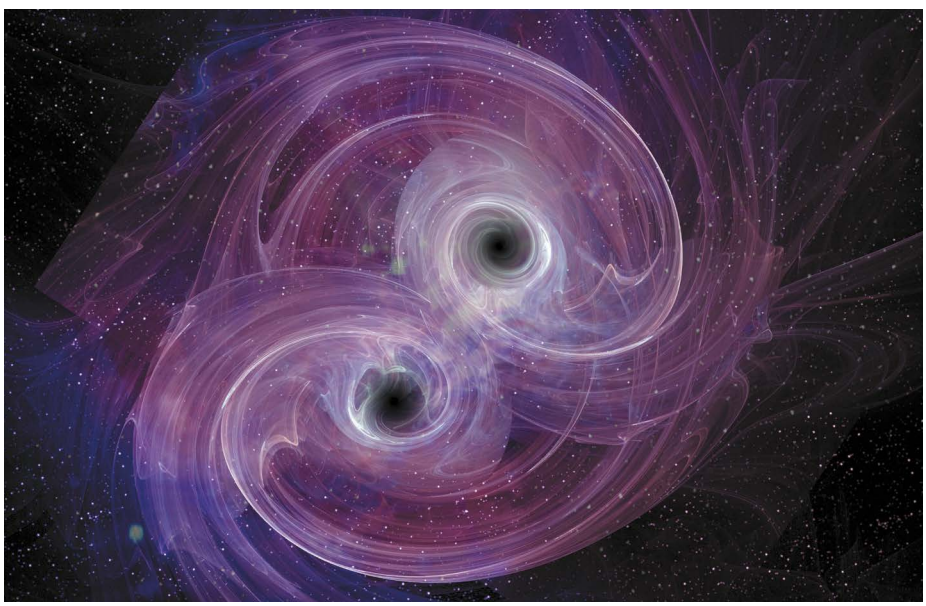
By Davide Castelvecchi

Astronomers have detected the most powerful, most distant and most perplexing collision of black holes yet, using gravitational waves. Of the two behemoths that fused when the Universe was half its current age, at least one — weighing 85 times as much as the Sun — has a mass that was thought to be too large to be involved in such an event. And the merger produced a black hole of nearly 150 solar masses, the researchers estimated, putting it in a range where no black holes had ever been conclusively seen before.

"Everything about this discovery is mindboggling," says Simon Portegies Zwart, a computational astrophysicist at Leiden University in the Netherlands. In particular, he says, the formation of the 150 solar mass black hole confirms the existence of 'intermediate mass' black holes: objects much more massive than a typical star, but not quite as big as the supermassive black holes that inhabit the centres of galaxies.

Ilya Mandel, a theoretical astrophysicist at Monash University in Melbourne, Australia, calls the finding "wonderfully unexpected".

The event, described in two papers published on 2 September[1,2], was detected on 21 May 2019, by the twin detectors of the Laser Interferometer Gravitational-Wave Observatory (LIGO) at Hartford, Washington, and Livingston, Louisiana, and by the smaller Virgo observatory near Pisa, Italy. It is named GW190521 after its detection date.



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An artist's impression of two colliding black holes.

Forbidden masses

Since 2015, LIGO and Virgo have provided new insights into the cosmos by sensing gravitational waves. These ripples in the fabric of space-time can reveal events such as the mergers of black holes that would not normally be visible with ordinary telescopes.

From the properties of the gravitational waves, such as how they change in pitch, astrophysicists can estimate the sizes and other features of the objects that produced them as these objects spiralled into each other. This ability has revolutionized the study of black holes, providing direct evidence for dozens of these objects, ranging in mass from a few to about 50 times the mass of the Sun.

These masses are consistent with black holes that formed in a 'conventional' way — when a very large star runs out of fuel to burn and collapses under its own weight. But the conventional theory says that stellar collapse should not produce black holes of about 65–120 solar masses. That's because towards the end of their lives, stars in a certain range of sizes become so hot at their centres that they start converting photons into pairs of particles and antiparticles — a phenomenon called pair instability. This triggers the explosive fusion of oxygen nuclei, which rips the star apart, completely disintegrating it.

In their latest discovery, the LIGO and Virgo detectors sensed only the last four ripples produced by the spiralling black holes, with a frequency that rose from 30 to 80 Hertz within one-tenth of a second. Whereas smaller black holes continue to 'chirp' up to higher frequencies, very large ones merge before this point, and barely enter the lower end of the frequency range to which the detectors are sensitive.

In this case, the two objects were estimated to weigh around 85 and 66 solar masses. "This is quite neatly in the range one would expect the pair-instability mass gap should be," says