

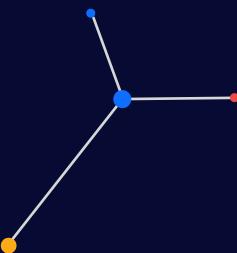
The **LOS ALAMOS CLUB**

How the People's Republic of China Recruited Leading
Scientists from Los Alamos National Laboratory to
Advance Its Military Programs

Table of Contents

Foreword	3
Executive Summary	4
Go Global—Play a “Useful Role” in Serving the Motherland	6
The PRC’s Talent Superpower Strategy & Its Targeting of Los Alamos National Laboratory	6
Building a Global Hub & Spoke Talent Network	7
The “Los Alamos Club”	9
SUSTech & Dr. Chen Shiyi.....	13
Hypersonics.....	14
Jet Engines	15
Deep-Earth Penetrating Warheads	16
Unmanned Autonomous Vehicles.....	17
Dr. Chen Continues to Support China’s Defense Industry via New Tech Company	17
He Guowei & China’s Submarine Noise-Reduction Programs.....	19
Conclusion	20
Appendix	21
Chen Shiyi and Defense Aerodynamics	21
Xu Ping and Wang Hsing-lin: Case Studies in Sending Talent Abroad	23
He Guowei and the PLA Navy	24

Foreword



The inspiration for this report comes from a March 2017 article in the *South China Morning Post* titled “America’s Hidden Role in Chinese Weapons Research.” The article notes that so many former Los Alamos National Laboratory scientists have returned to the People’s Republic of China (PRC) and are now working on military research programs that they are referred to as the “Los Alamos Club.” However, no specifics about this “Club,” its membership, or the programs these scientists are working on were reported.

The objective in conducting this study is to contextualize and document the ongoing efforts of the PRC government to send promising scientists to U.S. national laboratories for training while also recruiting leading scientists back to the PRC to advance its own military programs. Former Los Alamos scientists have made, and continue to make, considerable contributions to the PRC hypersonic, missile, and submarine programs that present an array of security risks for the United States and the entire free world. Better protection is needed for the institutions, research programs, and scientists advancing innovation in this era of strategic competition without harming open scientific collaboration.

This report does not suggest any illegal activities were conducted by any individual, university, professor, laboratory, or research institute named. Additionally, we do not argue that Los Alamos National Laboratory bears responsibility for, or was complicit in, the PRC’s recruitment of former Los Alamos affiliates.

Executive Summary

The People's Republic of China (PRC) is employing a Talent Superpower Strategy designed to incentivize academics, researchers, and scientists to go abroad, deepen their expertise, and return to China to advance its strategic interests.

What began in the 1980s as a program to send young talent overseas has evolved to incorporate initiatives that seek to harness these individuals' efforts for China's gain and, ultimately, encourage them to return to the PRC to work in key technology sectors.

The extent to which these initiatives are active in U.S. government laboratories is unknown. However, China's recruitment of individuals who have worked at the Los Alamos National Laboratory in New Mexico reflects the ambitions of the PRC's talent strategy and its exploitation of Western commitments to global scientific collaboration. The PRC's success among former Los Alamos affiliates, along with support for China's talent programs from Chinese

Communist Party (CCP) General Secretary Xi Jinping and other top CCP leaders, suggest that similar recruitment efforts may be widespread among U.S. government–funded laboratories, academic research institutions, and major centers of innovation. Moreover, the Los Alamos case shows how China's rapid advances in certain key military technologies are being aided by individuals who participated in sensitive U.S. government–funded research.

Between 1987 and 2021, at least 162 scientists who had worked at Los Alamos returned to the PRC to support a variety of domestic research and development (R&D) programs. Fifteen of those scientists worked as permanent staff members at Los Alamos. Of those fifteen, thirteen were recruited into PRC government talent programs; some were responsible for sponsoring visiting scholars and postdoctoral researchers from the PRC, and some received U.S. government funding for sensitive research. At least one of these staff members held a U.S. Department of Energy (DOE) "Q Clearance" allowing access to Top Secret Restricted Data and National Security Information.

Of the 162 returnees, at least 59 scientists were selectees of the PRC's flagship talent recruitment program—the Thousand Talents Program (TTP) and its youth branch, the Youth Thousand Talents Program (YTTP).

Ninety-eight of the scientists who returned were postdoctoral researchers, and 49 were visiting scholars. Although such individuals do not have access to the most sensitive research at Los Alamos, they still pose a risk of technology transfer and economic espionage. The DOE has acknowledged instances in which researchers elsewhere have passed dual-use and export-controlled research to the PRC via visiting students and scholars.

Since returning to China, Los Alamos alumni have helped the PRC advance key military and dual-use technologies in areas such as hypersonics, deep-earth penetrating warheads, unmanned autonomous vehicles (UAV), jet engines, and submarine noise reduction. A key member of this “Los Alamos Club” is Dr. Chen Shiyi, a world-renowned expert in

fluid dynamics and turbulence who spent the 1990s at the lab. After returning to China, Chen served as president of Southern University of Science and Technology (SUSTech), where he excelled at recruiting scientists with links to Los Alamos.

One of Chen Shiysi's first hires at SUSTech was former Los Alamos scientist Zhao Yusheng. During his 18-year career at Los Alamos, Zhao received at least 28 grants totaling \$19.8 million in U.S. government funding, including for sensitive research on deep-earth penetrating warheads. While at Los Alamos, Zhao sponsored a postdoctoral researcher who filed a national defense patent on similar technology after returning to the PRC. The researcher is now affiliated with the Chinese Academy of Engineering Physics (CAEP), the PRC's premier nuclear weapons R&D and production facility.

In addition to his role as a talent recruiter, Chen Shiysi has made major contributions to China's hypersonics and aerodynamics programs. Chen served as director of a state laboratory that played a key role in developing the PRC's hypersonic glide vehicle. Under Chen's leadership, the laboratory undertook projects with military organizations, defense industry enterprises, and PRC universities that collaborate closely with the People's Liberation Army (PLA). These projects have helped to contribute to the PRC passing the United States in hypersonic R&D.

He Guowei, another member of the “Los Alamos Club,” has been an important figure in the PRC's efforts to develop quieter submarines that are better able to evade detection. While at Los Alamos in the late 1990s, Dr. He engaged extensively with Chen Shiysi. After he returned to the PRC, Dr. He worked at the Chinese Academy of Sciences' Institute of Mechanics (IMCAS), where his team developed computer models that help to quickly and accurately predict turbulence generated by a submarine.

In recent years, China's state-sponsored talent programs have drawn increased scrutiny from Washington not only because of counterintelligence and intellectual property (IP) theft risks, but also because these programs are leveraging taxpayer-funded research to advance the PRC's economic development and military modernization.

The U.S. government has begun to take steps to mitigate the risks posed by the PRC's Talent Superpower Strategy.



However, more can be done by government-funded laboratories, research institutions, and private industry to identify potential counterintelligence and IP theft risks posed by individuals whose talent the PRC is seeking to leverage in its race for scientific and technological dominance. Moreover, it is an urgent national security imperative for like-minded nations to work together to protect their innovation centers and compete with China to attract, retain, and protect leading talent.

Play a “Useful Role” in Serving the Motherland

The PRC’s Talent Superpower Strategy & Its Targeting of Los Alamos National Laboratory

The People’s Republic of China (PRC) is employing a “Talent Superpower Strategy” (人才强国战略) designed to incentivize academics, researchers, and scientists to go abroad, deepen their expertise, and then work to advance China’s strategic interests. What began in the 1980s as policy to encourage young talent to go overseas and enhance their skill set has since evolved to include initiatives and programs that ultimately seek to exploit their efforts in vital technology sectors for China’s gain, whether they return to China or stay overseas.

This report documents the ambitions of the PRC’s talent strategy and its exploitation of Western commitments to global scientific collaboration. It does not argue that Los Alamos National Laboratory bears responsibility for, or was complicit, in the PRC’s recruitment of former Los Alamos affiliates. Yet the PRC’s success, along with support for China’s talent programs from Chinese Communist Party (CCP) General Secretary Xi Jinping and other top CCP leaders, suggest that similar recruitment efforts may be widespread among U.S. government–funded laboratories, academic research institutions, and major centers of innovation. Moreover, the Los Alamos case shows how China’s rapid advances in certain crucial military technologies are being aided by individuals who participated in sensitive U.S. government–funded research.¹

Building a Global Hub & Spoke Talent Network

How China's Talent Initiatives Leverage Overseas Institutions to Train and Recruit Talent

On June 23, 1978, Deng Xiaoping opened a new chapter in the PRC's drive to acquire foreign technology by declaring "thousands, or even tens of thousands, should be sent abroad rather than only a handful."² In 1993, resisting the impulse to turn inward in the wake of the Tiananmen Square Massacre, the CCP Central Committee issued a landmark edict that kept the PRC on the path of economic opening to the outside world.³ The decision also set the overall policy direction to "support of overseas study, encourage returning to China, freedom to come and go" ("支持留学、鼓励回国、来去自由的方针"),⁴ themes that were reiterated many times in the years that followed.⁵ In 2013, General Secretary Xi Jinping updated this formulation by adding a phrase that called on overseas scholars to **"play a useful role"** (发挥作用) in serving China's national strategies. Xi has called on the country to "do everything possible to create the conditions for overseas scholars who return to China to have ample scope to exercise their abilities and for overseas scholars who remain overseas to have a gateway to serve their country."⁶

As the number of overseas academics and researchers grew, the PRC implemented policies that financially incentivized overseas researchers to leverage their host institutions to train talent sent from China. In 2001, the PRC Personnel Department, Ministry of Education, Ministry of Science and Technology, Ministry of Public Security, and Ministry of Finance jointly issued a document titled, "Some Opinions on Encouraging Overseas Scholars to Serve Their Country."⁷ The document details "funding support" (经费支持) and "remuneration" (报酬) to "overseas scholars to serve the motherland through various methods while they are studying or working overseas" in order to "fully exploit overseas talent resources."⁸ The document specified seven services for which PRC scholars working overseas could be rewarded, including leveraging overseas institutes to help train talent.⁹

THE 7 SERVICES

1. Accept concurrent part-time technical work positions in China.
2. Coordinate research cooperation between overseas and Chinese entities.
3. Conduct research overseas that is commercialized by Chinese entities.
4. Commercialize patents and technology by establishing enterprises in China.
5. Leverage overseas institutes to help Chinese employers train their talent.
6. Introduce foreign technology into Western China.
7. Establish "intermediary organizations" to facilitate the introduction of foreign technology to China and create more methods to serve the country in addition to those listed above.



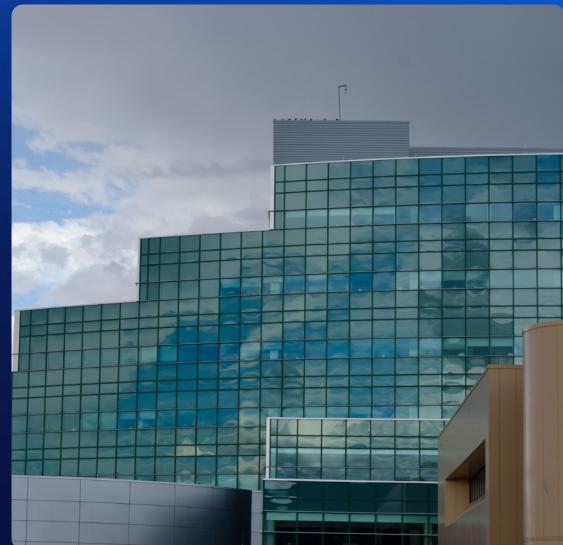
With a large and growing pool of researchers, academics, and scientists studying overseas, the PRC in the 1990s began to implement programs designed to encourage their return to China. In 1994, the Chinese Academy of Sciences (CAS) initiated the Hundred Talents Program (百人计划), an initiative specifically dedicated to the recruitment of overseas experts. Inspired by the success of the Hundred Talents Program, the PRC Ministry of Education in 1998 created the Changjiang Scholars Award Program (长江学者奖励计划) to recruit overseas talent to work in PRC research institutions. A decade later, the Thousand Talents Program (TTP) launched. Today, the PRC operates a constellation of more than 470 distinct talent programs at the central, provincial, municipal, and even institutional level that are aimed at recruiting top talent, especially overseas talent, for key PRC institutions.¹⁰

Previous research by Strider has detailed how PRC talent programs and funding schemes support the development of China's quantum research programs by sending scientists to top research labs around the world for training and then recruiting those scientists to return to China.¹¹ This approach is not limited to the quantum sector. Indeed, state-sponsored study abroad programs (公派) and other components of the CCP's Talent Superpower Strategy provide government financial incentives for scholars to use foreign institutes to help the PRC train talent.¹²

In the case of Los Alamos, at least 10 postdoctoral researchers and visiting scholars were funded by the PRC government's State-Sponsored Overseas Joint Training Doctoral Program (国家公派联合培养博士). Applicants to this program are given preference if their research aligns with specific technology needs outlined in PRC government plans or the personnel needs of state laboratories.¹³ Those who are selected are contractually required to return to China.¹⁴

Under this program, the joint training is coordinated by a doctoral advisor in the PRC and a host supervisor abroad, who is likely aware of an applicant's PRC government backing.¹⁵ At Los Alamos, for example, an online advertisement was posted in 2017 under the name of a permanent staff member for a postdoctoral position at the

lab's Center for Integrated Nanotechnologies (CINL). The Chinese-language version of the advertisement specifically sought out participants of the PRC government's State-Sponsored Overseas Joint Training Doctoral Program;¹⁶ the English version of the job posting, however, did not.



📍 NEW MEXICO

Los Alamos National Laboratory

The Los Alamos National Laboratory in New Mexico is the U.S. Department of Energy's premier research institution. Its mission—"to solve national security challenges through simultaneous excellence"—includes designing nuclear warheads, ensuring the safety and effectiveness of the U.S. nuclear stockpile, and finding innovative solutions to emerging threats in the cyber, space, and new technology domains.



At Los Alamos, permanent staff members are well positioned to identify, select, and train promising talent who could later return to China. These staff members are responsible for reviewing postdoctoral curriculum vitae (CV) and identifying candidates with skills matching Los Alamos research programs.¹⁷ Over the span of their careers, Los Alamos permanent staff—including those who eventually return to the PRC—often mentor dozens of postdoctoral researchers. For example, Dr. Zhao Yusheng, who served as a member of the permanent staff from 1996 to 2012, supervised and sponsored at least 25 postdoctoral researchers, at least eight of whom were from the PRC and later returned.¹⁸

Close interactions between PRC universities and the Ministry of State Security suggests that some postdoctoral researchers and visiting scholars are vetted by China's security services before going abroad.¹⁹ While they do not have access to the most sensitive research at Los Alamos, they still pose risks of technology transfer and economic espionage. The Department of Energy (DOE) has acknowledged instances where researchers elsewhere have passed dual-use and export-controlled research to the PRC via visiting students and scholars.²⁰

The "Los Alamos Club"

Former Los Alamos Affiliates Advancing China's Military Modernization

Overseas applicants who are inducted into a PRC talent program are typically contractually obligated (often unbeknownst to their overseas host institution) to host visiting scholars and postdoctoral researchers from the PRC and train them in their area of expertise.²¹ In effect, PRC talent programs are ever-expanding recruitment networks. Once inducted, participants are incentivized and obligated to identify top talent for placement in desirable research positions at their host institution and for eventual recruitment back to the PRC.

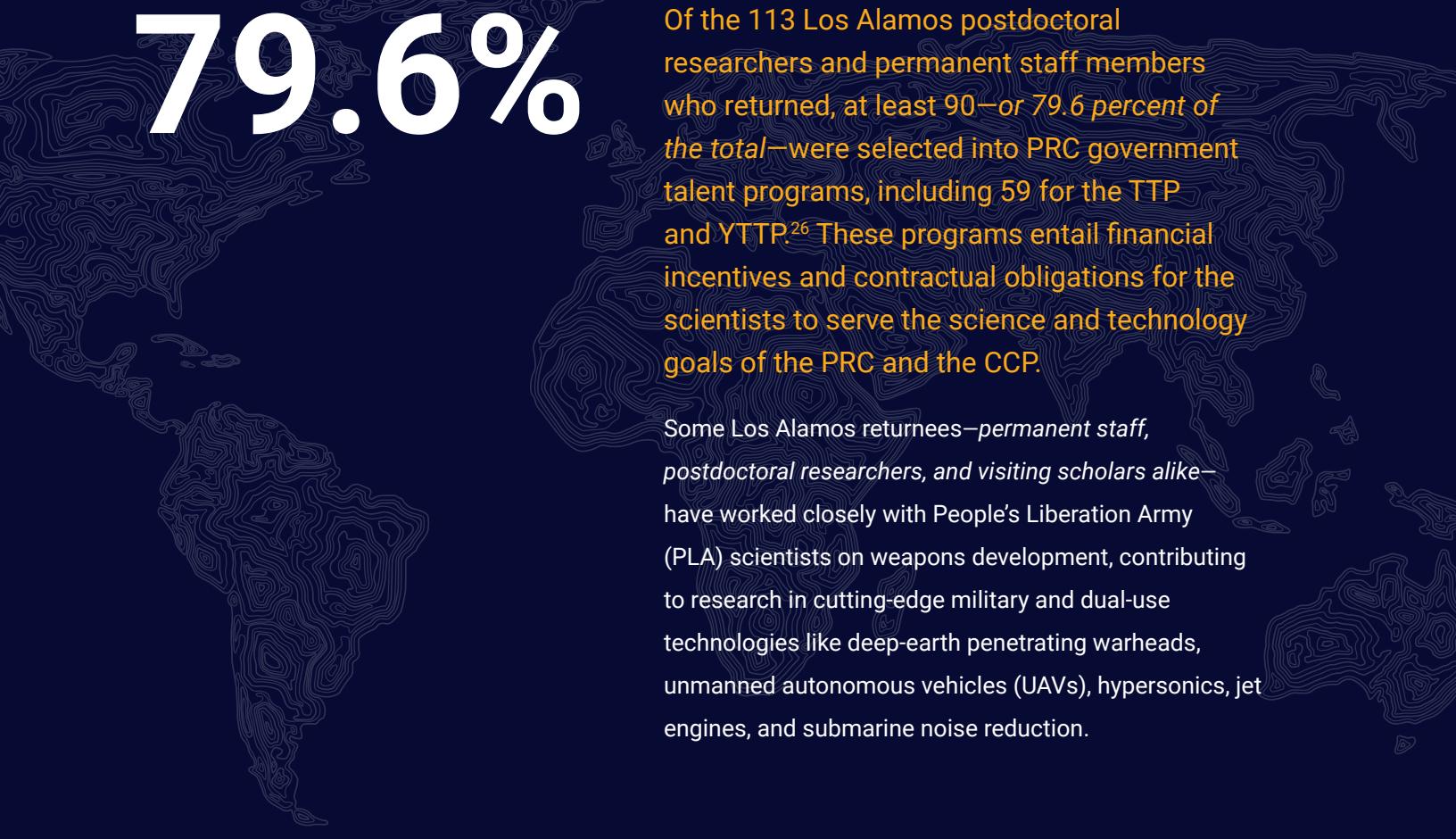


For example, at least two Los Alamos scientists have served as CAS Overseas Review Experts (中国科学院海外评审专家) prior to returning to the PRC. Established in 1999, the CAS Overseas Review Experts system is designed primarily to “encourage excellent individuals who are studying abroad to return to China and serve their motherland” and to “promote the recruitment of overseas talents and intelligence.”²² Those hired as overseas review experts must “have the intention to actively service the science and technology cause of the motherland.”²³

One of the most high-profile elements of the talent strategy has been the TTP, which was established in 2008 to recruit leading scientists, academics, and entrepreneurs to advance the PRC's interests. Oversight of the TTP fell under the CCP Central Committee Organization Department, a secretive party organ controlling personnel appointments within the Party. In 2019, the PRC folded all TTP programs into the "High-End Foreign Expert Recruitment Plan" (高端外国专家引进计划) managed by the PRC Ministry of Science and Technology.

Of the 162 Los Alamos scientists who have returned to China, at least 17, including 13 permanent staff members, were selected into the TTP. Members of the TTP receive RMB 1,000,000 (approximately USD \$155,000) and a research

subsidy of RMB 3 million to 5 million (approximately USD \$465,000 to \$775,000).²⁴ Forty-two scientists were selected for the TTP's youth branch, the Youth Thousand Talents Program (青年千人计划) or YTTP. Established in 2011, the YTTP recruits outstanding scientists under the age of 40 with the potential to greatly contribute to the achievements of PRC science and technology (S&T) and industrial objectives. YTTP selectees receive a one-time grant of RMB 500,000 (approximately USD \$77,500), a research subsidy of RMB 1 to 3 million (approximately USD \$155,000 to USD \$465,000), and appointments at PRC institutions.²⁵



79.6%

Of the 113 Los Alamos postdoctoral researchers and permanent staff members who returned, at least 90—or 79.6 percent of the total—were selected into PRC government talent programs, including 59 for the TTP and YTTP.²⁶ These programs entail financial incentives and contractual obligations for the scientists to serve the science and technology goals of the PRC and the CCP.

Some Los Alamos returnees—permanent staff, postdoctoral researchers, and visiting scholars alike—have worked closely with People's Liberation Army (PLA) scientists on weapons development, contributing to research in cutting-edge military and dual-use technologies like deep-earth penetrating warheads, unmanned autonomous vehicles (UAVs), hypersonics, jet engines, and submarine noise reduction.

Los Alamos Scientists Who Returned to the PRC

BY EMPLOYMENT TYPE

15

Permanent Staff

49

Visiting Scholars

98

Postdoctoral Researchers

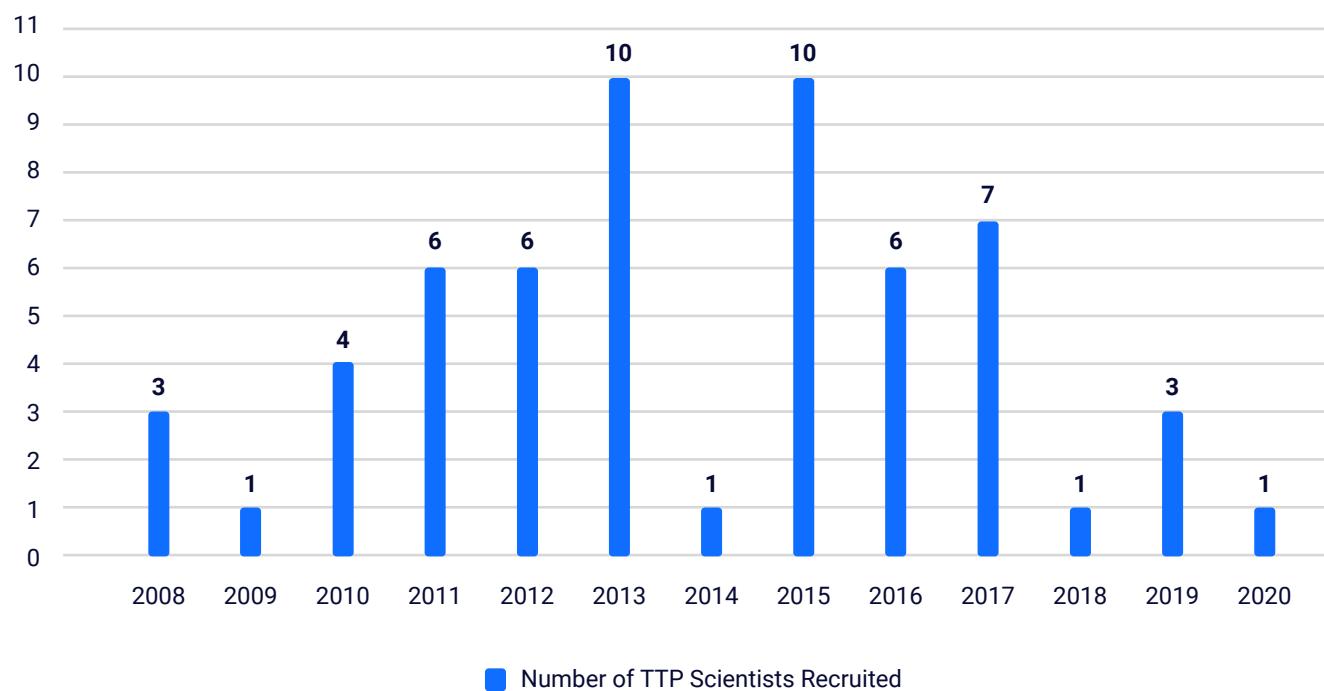
■ Permanent Staff

■ Postdoctoral Research

■ Visiting Scholars

Los Alamos Scientists Recruited into the Thousand Talents Program

BY YEAR



Recruitment from Los Alamos soared with the introduction of YTTP, which expanded the scope of potential recruits and peaked between 2013 and 2016, when upwards of 10 Los Alamos scientists returned to the PRC each year as TTP selectees.

- ➡ The ability to track TTP recruitment has declined since 2017. In October 2018 information related to the TTP began to disappear from Chinese open-source publications, probably because of increased scrutiny by the United States²⁷
- ➡ It is possible that the TTP's growth has declined in recent years as other PRC talent-recruitment tactics have evolved. The DOE began blocking scientists from participating in foreign government talent-recruitment programs in 2019.²⁸

SUSTech & Dr. Chen Shiyi

A Source of Expertise Driving the Development of Key PRC Military and Dual-Use Technologies

Former Los Alamos scientists are playing a key role in advancing China's science and technology programs, including military initiatives. In a 2017 article titled "America's Hidden Role in Chinese Weapons Research," the Hong Kong-based *South China Morning Post* reported that, "while the numbers remain unknown, so many scientists from Los Alamos have returned to Chinese universities and research institutes that people have dubbed them the 'Los Alamos Club.'"²⁹ While the total number of individuals who have returned to China following stints at U.S. government-funded labs is unclear, the individuals who have been identified are contributing to meaningful advances in China's military modernization, presenting a range of security challenges to the United States and its allies. The careers of a few of the scientists who previously worked at Los Alamos illustrate the ways and means by which PRC government programs recruit foreign-trained experts for strategic initiatives.

A central figure of the Los Alamos Club is Dr. Chen Shiysi (陈十一). Dr. Chen arrived at Los Alamos in 1990 and became one of the first PRC nationals to receive the Oppenheimer Fellowship, a distinguished fellowship reserved for the top postdoctoral applicants.³⁰ He served as deputy director of the lab's Center for Nonlinear Studies (CNLS) from July 1997 to January 2000. Chen joined Johns Hopkins University in 2001 and served as chair of the Department of Mechanical Engineering from 2002 to 2004 before becoming the Alonso G. Decker Chair in Engineering and Science in 2005.³¹ That same year, he returned to the PRC to establish Peking University's (PKU's) engineering college. Chen became a CAS Academician in 2013—a position reserved for those who make the greatest

contributions to PRC scientific research. From 2015 to 2020, he served as president of Southern University of Science and Technology (SUSTech) in Shenzhen, China.



SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY (SUSTECH)

Building "China's Stanford" in 10 Years on Recruitment from Los Alamos

- ➔ SUSTech is a public research university established in Shenzhen in 2010 by the Shenzhen municipal government. Nearly all SUSTech's direct financial support comes from the Shenzhen municipal government. Its stated ambition is to become "China's Stanford."
- ➔ At least 15 Los Alamos alumni are currently employed at SUSTech. For a relatively new institution, it employs a disproportionately high number of world-class scholars, most of whom were recruited via PRC government talent programs, transforming it into an important S&T center within the PRC.
- ➔ According to a report by a PRC Ministry of Education media outlet, more than 40 percent of SUSTech faculty are members of the TTP and the YTP.

As head of SUSTech, Dr. Chen excelled at recruiting scientists with Los Alamos links to the university. Many of these returnees had personal and professional ties to Chen. For his achievements, the Shenzhen municipal government honored Chen in 2017 with the title of "Shenzhen Talent Ambassador" (深圳人才大使).³² SUSTech currently hosts at least 15 Los Alamos alumni.

Former Los Alamos scientists now working at SUSTech



Shiyi
CHEN



Xiaowen
SHAN



Yusheng
ZHAO



Xiangling
WANG
(Hsing-lin WANG)



Dongxiao
ZHANG



Songbei
HAN



Zewei
QUAN



Shanmin
WANG



Jinlong
ZHU



Kaijun
LIU



Li
DONG



Yuejin
GUO



Ke
GAO



Yu
CHEN



Lianping
WANG

■ Permanent Staff

■ Postdoctoral Research

■ Visiting Scholars

HYPERSONICS

In addition to helping turn SUSTech into a premier research university in China, Chen Shiyi is a world-renowned expert in fluid dynamics and turbulence who has made major contributions to China's hypersonic missile and aerodynamics programs. He is a key figure in a PRC defense innovation system intentionally designed to blur the lines between civilian and military research.

Chen Shiyi joined PKU's State Key Laboratory of Turbulence and Complex Systems (LTCS) in 2005 and was its director from 2011 to about 2020.³³ He continued to lead LTCS during his 2015–2020 tenure as SUSTech president. Established in 1995, LTCS conducts fundamental and applied research on turbulence, aerospace mechanics, and complex flows. Chen is currently honorary director of the laboratory and vice director of LTCS' Academic Committee.³⁴ LTCS is organized around the staff, equipment, and facilities of PKU's College of Engineering, where Chen served as inaugural dean between 2005 and 2013.

Under Chen's leadership, LTCS played a key role in developing the PRC's hypersonic glide vehicle.³⁵ According to the LTCS website, the lab "actively participated in the development of

national strategic equipment and hypersonic wind tunnels."³⁶ This is a reference to PKU's quiet hypersonic wind tunnels,³⁷ the first of which was one of only three in the world when it was built between 2010 and 2011.³⁸ Compared with conventional hypersonic wind tunnels, quiet wind tunnels more accurately simulate in-flight conditions for objects flying at hypersonic speeds.



- ➔ Using data from PKU's quiet hypersonic wind tunnels, LTCS claimed that it made contributions that were "invaluable in the design of hypersonic vehicles."³⁹
- ➔ According to the PKU College of Engineering's Hypersonic Quiet Wind Tunnel Laboratory (高超声速静风洞实验室)—a facility used by LTCS staff—research using wind tunnels built during Chen's time as PKU engineering dean and LTCS director "made important contributions" that allowed "[the PRC] to surpass the U.S. in airbreathing [hypersonic] vehicle research and development."⁴⁰

HYPERSONICS (CONT.)

LTCS occupies a central role in a wider network of organizations involved in PRC hypersonic and defense aerodynamics research. During Chen's tenure as director, LTCS undertook major national projects with military organizations such as the National University of Defense Technology (NUDT) and the China Aerodynamics Research and Development Center (CARDC), defense-industry enterprises such as China Aerospace Science and Technology Corporation's (CASC) 11th Academy, as well as members of the Seven Sons of National Defense, a grouping of PRC universities that collaborate closely with the PLA.⁴¹

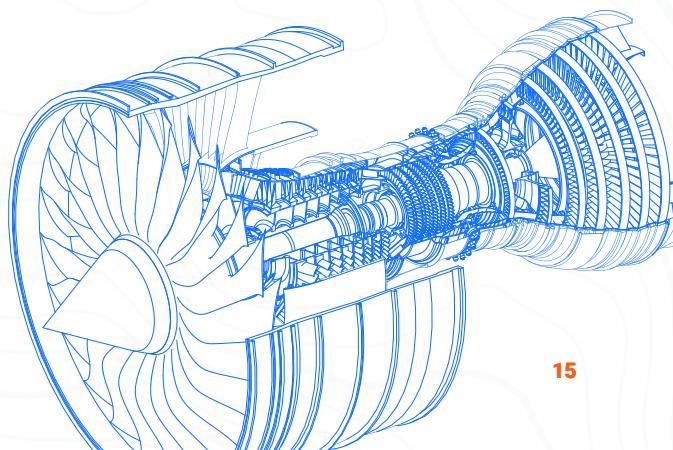
- ➔ In 2013, Chen and LTCS cohosted a symposium with NUDT's Defense S&T Key Laboratory of Hypersonic Ramjet Technology (高超声速冲压发动机技术国防科技国家重点实验室) on engine detonation, a field relevant for hypersonic propulsion.⁴²
- ➔ Shortly after Chen stepped down as director in 2020, LTCS began discussions to establish a joint state laboratory with CASC's Third Academy, the PRC's premier enterprise engaged in cruise missile design and production.⁴³

As recently as March 2020, Chen was serving as a member of the academic committee of the CARDC State Key Laboratory of Aerodynamics.⁴⁴ In this position, Dr. Chen was responsible for managing research objectives and annual work plans. CARDC, also known as the PLA's 29th Testing and Training Base (Unit 63820), is the PRC's largest aerodynamics research and testing institute and serves as China's primary hypersonic test facility.⁴⁵ The laboratory conducts aerodynamic modeling in areas such as hypersonic boundary layer transition, weapons bay aeroacoustics, and advanced fighter maneuvers.⁴⁶ Since 1999, CARDC has been on the U.S. Department of Commerce's Entity List, a trade-restriction list of individuals and entities conducting activities deemed contrary to the national security or foreign policy interests of the United States.⁴⁷

JET ENGINES

Chen Shiyi also served on an Expert Steering Group of a major National Science Foundation of China (NSFC) research plan on jet engine development in China. The NSFC is a PRC government body that advances basic research in support of PRC strategic needs. NSFC Expert Steering Groups usually consist of seven to nine experts responsible for overall project guidance, implementation, and review of NSFC research plans.⁴⁸ In 2014 NSFC launched the Fundamental Research on Turbulent Combustion for Engines Major Project Research Plan (面向发动机的湍流燃烧基础研究重大研究计划), an eight-year research effort aimed at resolving key technological bottlenecks in indigenous engine development, a longstanding impediment in PRC domestic civilian and military aircraft design and production.⁴⁹

- ➔ The organizations charged with conducting the research for this NSFC project include three PLA institutions—NUDT, Air Force Engineering University (AFEU), and CARDC—along with two state-owned defense-industry giants—China Academy of Aerospace Aerodynamics (also known as the CASC 11th Academy) and the Shenyang Aeroengine Research Institute (also known as the AVIC 606 Institute).⁵⁰
- ➔ CARDC organizes the project's annual conferences on NSFC's behalf, while its Air-breathing Hypersonic Technology Research Center (吸气式高超声速技术研究中心) hosts the project's web page.^{51 52}
- ➔ Shan Xiaowen, a SUSTech professor and former Los Alamos permanent staff member, contributed to the project in 2017 by leading an examination into the effects of combustion on turbulence under engine conditions.⁵³



DEEP-EARTH PENETRATING WARHEADS

One of Chen Shiyi's first hires as the president of SUSTech was his former Los Alamos colleague, Zhao Yusheng (赵予生). During his 18-year career at Los Alamos, Zhao received at least 28 grants totaling \$19.8 million in U.S. government funding for sensitive research.⁵⁴ From 2004 to 2005, Zhao led a DOE—Department of Defense (DOD) project entitled “Nanostructured Superhard Noses for Deep-Penetrating Warheads.”⁵⁵ Zhao was also granted a DOE “Q Clearance”—allowing access to Top Secret Restricted Data and National Security Information—and led the lab’s team researching high-pressure materials.⁵⁶

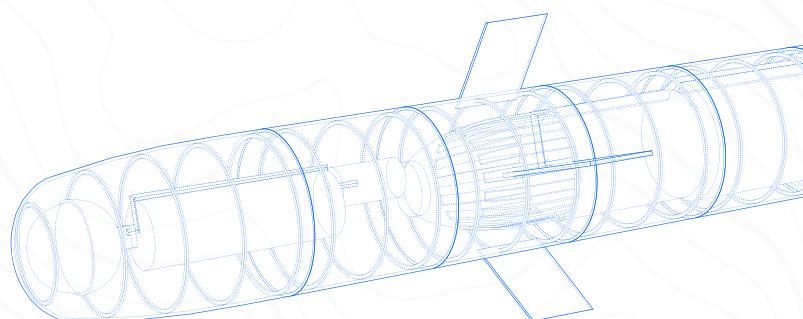
- ➔ Zhao left Los Alamos in 2010 to lead the University of Nevada, Las Vegas (UNLV) High-Pressure Science and Engineering Center (HiPSEC)—a position that also required a Q Clearance—where he received approximately \$2.9 million in DOE funding for research into new battery materials.⁵⁷
- ➔ Zhao was inducted into the TTP in 2016 and returned to China, where he has since served in several SUSTech leadership roles, including associate vice president, dean of its Academy of Advanced Interdisciplinary Studies, director of its Office of Research, and chair professor in SUSTech’s Physics Department.⁵⁸

Further review suggests that one of the 25 postdoctoral researchers Zhao sponsored at Los Alamos, He Duanwei (贺端威), likely leveraged or replicated Los Alamos research on materials for use in hypersonic, deep-earth penetrating warheads after he returned to the PRC in 2006. Dr. He worked as a postdoctoral research associate at Los Alamos from 2000 to 2003, with some information suggesting he remained employed at the lab until 2005.⁵⁹ In a 2004 edition of a Los Alamos publication, *Nuclear Weapons Journal*, Zhao described how research on superhard nanocomposites was “highly promising for hypersonic high-speed penetration” and noted that “superhard materials in warhead penetrators [would] significantly

enhance technological advantages of U.S. weaponry.”⁶⁰ Dr. Zhao claimed that this research was conducted with the U.S. Navy.⁶¹ Three years later, in 2007, Dr. He filed a national defense patent in China on a similar technology for an “ultra-thick penetrating warhead”⁶²

- ➔ Following the approval of the patent in 2011, Dr. He co-led a Major National Defense Special Project (国防重大专项) subproject on synthesizing superhard nano-polycrystalline diamonds in China.⁶³
- ➔ The project involved a scientist working for the Chinese Academy of Engineering Physics’ (CAEP) Laboratory of Shock Wave Physics and Detonation Physics (冲击波物理与爆轰物理实验室).⁶⁴
- ➔ CAEP is the PRC’s nuclear weapons R&D and production facility. The CAEP Laboratory of Shock Wave Physics and Detonation Physics is also known in Chinese-language sources as the National Defense Key Laboratory of Shock Wave and Detonation Physics (冲击波物理与爆轰物理国防重点实验室).⁶⁵

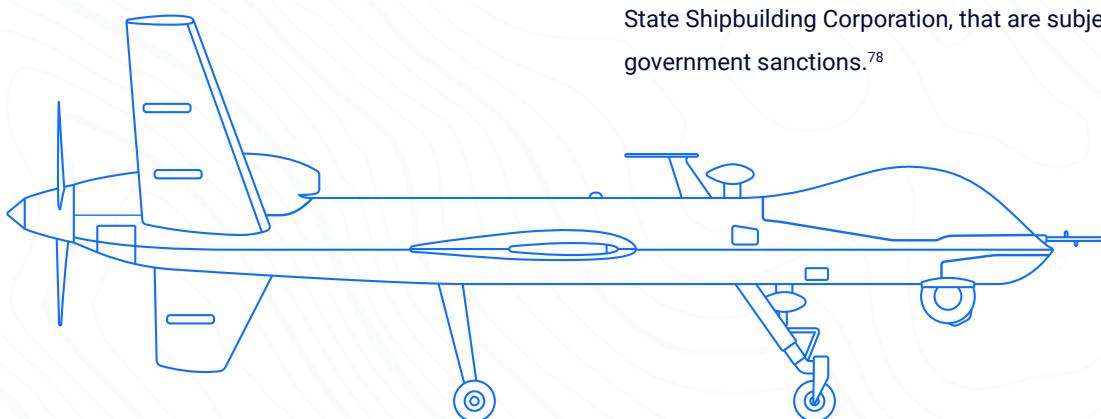
Dr. He currently serves as director of the Sichuan University Institute of Atomic and Molecular Physics (四川大学原子与分子物理研究所), where he also heads the High Temperature and High Pressure Physics Laboratory (高压科学与技术实验室), which is jointly administered by CAEP.⁶⁶ Both Sichuan University and CAEP are subject to U.S. government export controls for their role in China’s nuclear program. Dr. He also leads the high-pressure physics group at the Ministry of Education Key Laboratory of High Energy Density Physics and Technology (高能量密度物理及技术教育部重点实验室), a defense-oriented laboratory whose website states that its research is conducted in pursuit of the PRC’s Medium and Long-Term Defense S&T Development Plan.⁶⁷



UNMANNED AUTONOMOUS VEHICLES

In 2016, Chen Shiyi recruited Shan Xiaowen (单肖文) to serve as chair professor in SUSTech's Department of Mechanics and Aerospace Engineering. Dr. Shan became head of the SUSTech Intelligent Aviation R&D Center in 2019, which focuses on unmanned aerial vehicle (UAV) technologies. Under Shan's leadership, the center produced a prototype Vertical Take-Off and Landing (VTOL) UAV with both civil and military applications.⁶⁸ The center is located in the same state-organized industrial cluster that hosts testing and production facilities for military drones, an example of PRC efforts to integrate civilian research with military end users.⁶⁹

- ➔ Shan worked at Los Alamos from 1991 to 1998, first as a postdoctoral researcher and then as a permanent staff member. He collaborated with Chen in the early 1990s on Lattice Boltzmann methods (LBM), a form of computational fluid dynamics commonly used in the aerospace industry.⁷⁰
- ➔ After becoming a member of the Los Alamos permanent staff, Shan conducted research as a visiting fellow at the U.S. Air Force Research Laboratory.⁷¹ Dr. Shan returned to the PRC in 2011 as a TTP selectee and joined the Commercial Aircraft Company of China (COMAC) as director of aerodynamics at the company's Beijing Research Center. In this capacity, he led the preliminary design of the PRC's first domestically produced wide-body commercial aircraft, the C919, a project notorious for allegations of industrial espionage.⁷²



DR. CHEN CONTINUES TO SUPPORT CHINA'S DEFENSE INDUSTRY VIA NEW TECH COMPANY

Dr. Chen remains active in China's defense innovation ecosystem. Since stepping down from his position as SUSTech president in 2020, Chen established a computer-aided engineering software company called Shenzhen Shifeng Technology Co., Ltd. (深圳十沣科技有限公司, aka TenFong). Chen linked the company's establishment to wider efforts in the PRC to create industrial software independent from foreign suppliers.⁷³ Chen's company has a number of links to the PRC defense industry:

- ➔ In late 2021, Shenzhen Shifeng was one of three companies vying for a contract to upgrade heat-flow-analysis software for the China Airborne Missile Academy (中国空空导弹研究院).⁷⁴
- ➔ In June 2022, the company acquired Nanjing Youyi Intelligent Technology Co., Ltd. (南京友一智能科技有限公司).⁷⁵ Youyi's product line includes FlightSim, a simulation software with advertised applications in ballistic missile flight modeling, including simulation of coordinated salvo launches.⁷⁶
- ➔ Shenzhen Shifeng's Xi'an branch is led by Qu Kun (屈昆) and Cai Jinsheng (蔡晋生), professors at Northwestern Polytechnical University, a Seven Sons school, who have headed multiple classified defense aerospace projects in China.⁷⁷
- ➔ Shenzhen Shifeng has entered into cooperative ventures with at least two companies, Qihoo 360 and China State Shipbuilding Corporation, that are subject to U.S. government sanctions.⁷⁸

THE LOS ALAMOS CLUB

Beyond SUSTech

Los Alamos alumni who are not connected with SUSTech are also contributing to research in highly strategic technology and contributing to PRC defense research, but the scope and scale of these efforts is unclear. These individuals include visiting scholars, postdoctoral researchers, and permanent staff.



At least 13 either work for or have participated in research sponsored by defense organizations such as the Central Military Commission (CMC) and SASTIND.



At least seven have ties to the Chinese Academy of Engineering Physics (CAEP), the primary R&D and production facility for the PRC's nuclear weapons program.



At least four former Los Alamos postdoctoral researchers currently work at the State Key Laboratory of Electronic Thin Films and Integrated Devices (SKLETFID), two of whom received national defense S&T awards for their contributions. The facility received more than half of its funding from defense entities between 2012 and 2017. SKLETFID's accomplishments include producing multispectral camouflage materials for an unnamed stealth fighter, developing advanced sensors for aircraft engines, and providing infrared detectors for PLA aircraft.

One former Los Alamos permanent researcher led research for both the U.S. military and the PLA while concurrently employed as a professor at a U.S. university and as a Thousand Talents selectee at Nanjing University of Science and Technology (NJUST). NJUST is a member of the Seven Sons of National Defense, a group of universities that collaborate closely with the PLA.

- ➔ Between 2009 and 2015, the individual received approximately \$1.8 million from the U.S. Army Research Office, the U.S. Army Research Laboratory, the U.S. Air Force Office of Scientific Research, and the U.S. Air Force Small Business Innovation Research (SBIR) Program for research on advanced materials.
- ➔ While conducting research on advanced materials for the U.S. military, this individual presided over a 390 million RMB project from the CMC S&T Commission's Major Frontier Innovation Program (军委科技委前沿创新重大项目) that made breakthroughs in titanium aluminide (TiAl) alloys, a lightweight material with applications in defense aerospace.
- ➔ The former Los Alamos researcher collaborated on this project with a researcher who had previously spent time at Oak Ridge National Laboratory as a visiting scholar. The former Oak Ridge visiting scholar later won the PRC's highest-level defense S&T prize in 2021 for a separate project.

He Guowei & China's Submarine Noise-Reduction Programs

Former Los Alamos visiting scholar He Guowei (何国威) is a key figure in the PRC's efforts to deploy quieter submarines that are better able to evade detection—a hallmark of the world's most modern navies.

Dr. He was a visiting scholar at the Los Alamos CNLS in the late 1990s when Chen Shiyi served as deputy director of the CNLS lab and it is possible that Chen recruited He to come to Los Alamos.⁷⁹ The two cooperated extensively at the lab, publishing seven articles together between 1998 and 1999.⁸⁰

- ➡ Dr. He joined the staff of the Chinese Academy of Sciences Institute of Mechanics (IMCAS) in 1991 as a postdoctoral researcher and rose through the ranks to become director of its State Key Laboratory of Nonlinear Mechanics (LNM) in 2006.⁸¹
- ➡ In the interim, He was a visiting scholar at the French National Centre for Scientific Research (1995–1997), at Los Alamos (1997–2000), and at the Institute for Computer Applications in Science and Engineering (ICASE) at the NASA Langley Research Center (2000) before returning to the PRC as a selectee of the CAS Hundred Talents Program.

He's team at the IMCAS LNM developed computer models that help to quickly and accurately predict turbulence generated by a submarine.⁸² As of 2019, He continued to pursue research in the “intelligent identification theory of submarine turbulence noise” at IMCAS.⁸³ Most of the PRC's other preeminent experts in submarine noise reduction technology are PLA scientists.⁸⁴



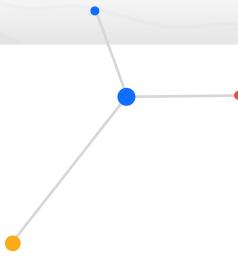
Concussion

China's recruitment of individuals who have worked at the Los Alamos National Laboratory reflects the evolution of the PRC's overall talent strategy and shows how China's rapid advances in certain key military technologies are being aided by individuals who may be applying knowledge obtained while participating in sensitive U.S. government–funded research.⁸⁵ The PRC's success at Los Alamos, and support for China's talent programs by Xi Jinping and other top CCP leaders, suggest that similar efforts may be widespread at other U.S. government–funded laboratories, research institutions, and major centers of innovation.

The U.S. government has begun to take steps to mitigate these risks. In recent years, the PRC's state-sponsored talent programs, such as the TTP, have drawn increased scrutiny from Washington not only because of counterintelligence and intellectual property (IP) theft risks, but because these programs are leveraging taxpayer-funded research to advance the PRC's economic development and military modernization. According to a 2019 Senate report, PRC talent programs violate U.S. research values, target U.S. basic research, and erode U.S. economic competitiveness. That same year, the DOE issued guidance prohibiting involvement by its employees or contractors in foreign talent-recruitment plans.

- ➔ Several persons connected to the TTP have been indicted by the U.S. Department of Justice. In May 2022, a federal judge sentenced Xiaorong "Shannon" Yu, a chemical engineer and TTP applicant, to 14 years in prison for conspiring to steal trade secrets for the benefit of a PRC-based company.
- ➔ In December 2021, a federal jury found Harvard chemist Charles Lieber guilty of making false statements and tax offenses related to his participation in the TTP and his undisclosed affiliation with a PRC university.

However, more can be done by government-funded laboratories, research institutions, and private industry to identify potential counterintelligence and IP theft risks posed by individuals whose talent the PRC is seeking to leverage in its race for science and technology dominance. Moreover, it is an urgent national security imperative for like-minded nations to work together to protect their innovation centers and compete with China to attract, retain, and protect leading talent.



Appendix

Former affiliates of Los Alamos are central to the networks of scientists engaged in China's defense modernization and pursuit of civil-military fusion. This appendix offers additional insight and context into the personalities, relationships, and organizations in China involved in that work.

Chen Shiyi and Defense Aerodynamics

While Chen Shiyi guided LTCS and PKU participation in the PRC's development of hypersonic glide vehicles, the LTCS's leadership included military scientists linked to CARDC.

→ **Zhang Hanxin** (张涵信), a CARDC researcher and former CARDC deputy chief engineer, served as the LTCS academic committee director when Chen joined LTCS in 2005. Chen served as Zhang's deputy on the LTCS academic committee, and in 2006, Chen hired Zhang as an LTCS adjunct professor.⁸⁷ At that time, Zhang held a specialized technical major general rank and was well known in PRC aerodynamics circles for his national defense contributions, notably "developing three major software systems for the aerodynamic design of aircraft, tactical missiles, and re-entry warheads."⁸⁸

→ **Deng Xiaogang** (邓小刚) currently serves under Chen on the LTCS academic committee.⁸⁹ Deng is a CAS Academician who led the PLA's NUDT from 2017 to 2019. Deng held the rank of specialized technical major general and was chief engineer at CARDC, where he served as the inaugural director of the center's State Key Laboratory of Aerodynamics⁹⁰ and "presided over the development and testing of hypersonic wind tunnels and resolved problems in the development of many major weapons and equipment, including...advanced fighter jets, missiles, and hypersonic vehicles."⁹² In 2020, the PLA elevated Deng to vice president of the Academy of Military Sciences, the PLA's highest-level research institute.⁹³

Chen Shiyi and Defense Aerodynamics (Cont.)

In addition, Chen has worked closely with senior PLA scientists on multiple Expert Steering Groups for NSFC Major Research Plans (重大研究计划). NSFC Expert Steering Groups usually consist of seven to nine experts responsible for overall project guidance, implementation, and review of NSFC research plans.⁹⁴

In 2017, Chen was tapped to head the Expert Steering Group for the NSFC Major Research Plan for Generation, Evolution, and Action Mechanism of Turbulent Structures (湍流结构的生成演化及作用机理重大研究计划). Chen's fellow Expert Steering Group members included several PLA and PRC defense-industry scientists, including:⁹⁵

- ➡ **Sun Mingbo** (孙明波), an expert in hypersonic propulsion technologies, is a professor at NUDT and director of the university's Key Laboratory of Hypersonic Ramjet Technology (高超声速冲压发动机技术重点实验室).⁹⁶
- ➡ **Shen Qing** (沈清) leads the Science and Technology Committee of the CASC 11th Academy.
- ➡ **Deng Xiaogang** (See bio on previous page).

In 2014, the NSFC launched the Fundamental Research on Turbulent Combustion for Engines Major Project Research Plan (面向发动机的湍流燃烧基础研究重大研究计划).⁹⁷ Once again, Chen participated in the plan's Expert Steering Group alongside military scientists:

- ➡ **Gan Xiaohua** (甘晓华), an aeroengine specialist, serves as head of the Expert Steering Group, Chinese Academy of Engineering (CAE) Academician, and chief engineer at the PLA Air Force Equipment Academy (中国解放军空军装备研究院).⁹⁸ In 2010, Gan received a personal commendation by General Secretary Hu Jintao for his role in developing the J-20 stealth fighter's thrust vectoring engines. In 2014, Chen hired Gan as an adjunct professor at LTCS. In May 2017, Chen appointed Gan as a chair professor in SUSTech's Department of Mechanics and Engineering.⁹⁹
- ➡ **Le Jialing** (乐嘉陵), is deputy head of the Expert Steering Group, CAE Academician, and former CARDC researcher on the aerodynamic design of strategic missiles, launch vehicles, and hypersonic vehicles. Le concurrently acts as the National Defense S&T Key Laboratory of Hypersonic Ramjets (高超声速冲压发动机国防重点实验室) academic committee director and as a researcher at the Academy of Military Sciences (军事科学院, AMS), the PLA's highest-level research institute. When Xi Jinping visited AMS in May 2018, Le was part of a small group of defense researchers to receive a private audience with the General Secretary.¹⁰⁰

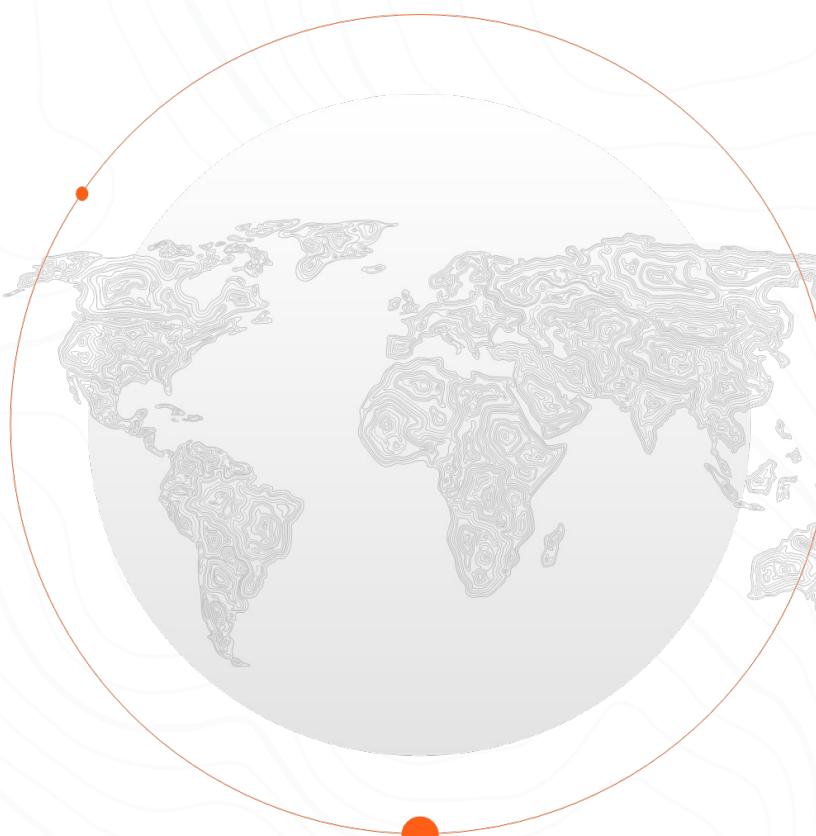
Xu Ping and Wang Hsing-lin: Case Studies in Sending Talent Abroad

In 2005, Xu Ping (徐平) was identified and honored as an Outstanding Graduate of the Harbin Institute of Technology (HIT) by the PRC's Commission for Science, Technology and Industry for National Defense (COSTIND). HIT is one of the PRC's Seven Sons of National Defense.

- During his PhD program at HIT, Xu also served as PRC government State-Sponsored Overseas Joint Training Doctoral Program scholar at Los Alamos from 2008 to 2009.
- After completing his doctoral program in 2010, Xu became a postdoctoral researcher at HIT until 2014 under CAE Academician Zhou Yu (周玉). At the time Zhou was leading PRC government–funded research into heat-resistant ceramic matrix composites that were later used on satellites, rockets, and hypersonic vehicles.¹⁰¹
- During this time, Xu was sponsored by Los Alamos permanent staff member Wang Hsing-lin (王湘麟) to return to the lab as a Director's Postdoctoral Fellow. After departing Los Alamos in 2013, Xu was inducted into the HIT Basic Research Outstanding Talent Cultivation Program (哈工大基础研究杰出人才培育计划) in 2014.¹⁰²
- Xu is currently a professor and vice dean of the HIT School of Chemistry and Chemical Engineering.¹⁰³ Zhou served as the president of HIT from 2014 to 2021.

Xu's 2012 sponsor, Wang Hsing-lin, is the longest tenured Los Alamos researcher to go to the PRC as a TTP selectee. Wang spent 21 years, from 1995 to 2016, at Los Alamos' Chemistry Division, first as a postdoctoral researcher and then as a member of the permanent staff.^{104 105}

- During his Los Alamos tenure, Wang also served as a subject-matter expert at the DOD Homeland Defense and Security Information Analysis Center (HDIAC).¹⁰⁶
- In 2016, Wang was recruited into the TTP and returned to the PRC as a chair professor of the Department of Material Science and Engineering at SUSTech under Chen Shiyi.¹⁰⁷



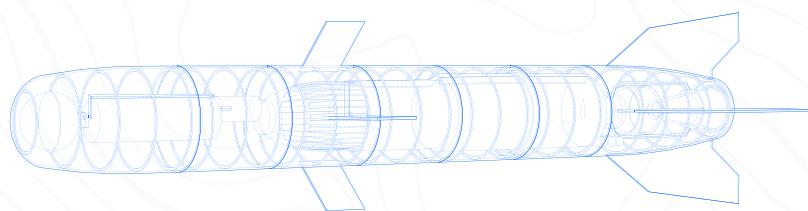
He Guowei and the PLA Navy

Several PLA scientists serve alongside Dr. He on the Academic Committee of the Shanghai Jiaotong University State Key Laboratory of Ocean Engineering (海洋工程国家重点实验室, SKLOE). These include:

- **He Lin** (何琳), a CAE Academician, specialized technical rear admiral, and professor at the PLA Naval University of Engineering, where he established the National Defense S&T Key Laboratory of Submarine Acoustic Stealth Technology (潜艇声隐身技术国防科技重点实验室) in 2011.
- **Wu Yousheng** (吴有生), a CAE Academician who as of 2020 directed the PRC's Central Military Commission S&T Commission Naval Warfare Expert Group.¹⁰⁸
- **Qiu Zhiming** (邱志明), a CAE Academician and weapons researcher at the PLA Naval Research Academy who designed the Type 730 close-in weapon system (CIWS) and made technical breakthroughs in vertical launching systems (VLS).¹⁰⁹
- **Zhu Yingfu** (朱英富), a CAE Academician who was chief designer for both the PRC's first guided missile destroyer with true air defense capability and its first aircraft carrier.¹¹⁰
- **Yang Desen** (杨德森), a CAE Academician and Harbin Engineering University professor who directs the National Defense S&T Key Laboratory of Underwater Acoustic Technology (水声技术国防科技重点实验室) and was a member of the PLA General Armaments Department Submarine Vibration Dampening and Noise Reduction Technology Expert Group.¹¹¹

The SKLOE is emblematic of how research at certain PRC labs straddle the line between civilian and military research. Highlighting its dual-use missions, its website declares that it "is positioned to pay equal attention to applied basic research, national defense scientific research, [and] civilian scientific research."¹¹² Some of its research is clearly military oriented:¹¹³

- Development of hydrodynamic and hydro-ballistic models for underwater launch of submarine-launched missiles.
- A classified project from 2014–2015 on maritime sensing technology sponsored by a unit of the former PLA General Staff Department.
- A NSFC Key Project entitled "Collaborative Monitoring of Underwater Moving Targets Based on Dynamic Multi-source Information."
- A classified project from 2017–2019 sponsored by the former PLA General Armaments Department.
- Research pertaining to submarine maneuverability and stealth, including vibration and noise reduction.



Footnotes

¹These activities are not limited to U.S. national laboratories, or even to the U.S. In early 2022, an investigation by Deutsche Welle found that dozens of PRC researchers sponsored by the German government to study in Germany now conduct military research. See "How a Humboldt Commission fellow joined China's military commission," Deutsche Welle, March 20, 2022, <https://www.dw.com/en/how-a-humboldt-foundation-fellow-joined-chinas-military-commission/a-61858074>.

²"6月23日，一个值得中国人记住的日子 [June 23, a Day Worth Remembering for Chinese People]," 中国网教育频道 [China Net Education Channel], June 26, 2019, accessed June 1, 2022, http://edu.china.com.cn/2019-06/26/content_74923429.htm.

³"中共中央关于建立社会主义市场经济体制若干问题的决定 [Decision of the CPC Central Committee Regarding a Number of Issues Concerning the Establishment of a Socialist Market Economy]," Central Committee of the Communist Party of China, November 14, 1993, accessed May 4, 2022, <http://www.people.com.cn/item/20years/newfiles/b1080.html>.

⁴"中共中央关于建立社会主义市场经济体制若干问题的决定 [Decision of the CPC Central Committee Regarding a Number of Issues Concerning the Establishment of a Socialist Market Economy]", Article 43. Article 43 of the Decision also calls for "adopting various forms, encourage overseas talent to serve the motherland" (采取多种形式，鼓励海外人才为祖国服务) alongside the policy direction.

⁵For example, "‘九五’期间人事系统留学人员工作规划 [The Personnel System Work Plan for Overseas Students During the ‘Ninth Five-year Plan’ Period]," Section 2(3); 留学人员回国工作“十一五”规划 [Eleventh “Five-year Plan” for Overseas Students Returning to Work in China], Section 2(1) and "留学人员回国工作‘十二五’规划 [Twelfth “Five-year Plan” for Overseas Students Returning to Work in China]," Section 2(1).

⁶"习近平在欧美同学会成立100周年庆祝大会上的讲话 [Xi Jinping’s Speech at the Celebration of the 100th Anniversary of the European and American Alumni Association]," [中华人民共和国中央人民政府] The Central People’s Government of the People’s Republic of China, October 21, 2013, accessed June 2, 2022, http://www.gov.cn/ldhd/2013-10/21/content_2511441.htm.

⁷In 2009, the PRC government launched a new initiative based on this 2001 policy – the 海外赤子为国服务行动计划[Homeland-Serving Action Plan for Overseas Chinese] (hereafter Serve the Homeland Action Plan), which is still implemented each year. The 2009 initiatives governing policy document, 关于实施海外赤子为国服务行动计划的通知 [Notice on Implementing the Serve the Homeland Action Plan], Section 1, cites as a "policy guarantee" the 关于鼓励海外留学人员以多种形式为国服务的若干意见 [Some Opinions on Encouraging Overseas Scholars to Serve Their Country]. The PRC Ministry of Human Resources and Social Security (MOHRSS) called the Homeland-Serving Action Plan for Overseas Chinese a "new brand" for overseas scholars serving the country in an article on its website titled: 赤子计划：树立留学人员为国服务新品牌. See "赤子计划：树立留学人员为国服务新品牌 [Homeland-Serving Action Plan: Establish a New Overseas Brand of Overseas Students Serving the Country]," Ministry of Human Resources and Social Security of the People’s Republic of China, April 12, 2013, accessed June 1, 2022, http://www.mohrss.gov.cn/zysrygl/ZYJSRYGLsgongzuodongtai/201304/t20130412_98050.html.

⁸关于鼓励海外留学人员以多种形式为国服务的若干意见 [Some Opinions on Encouraging Overseas Scholars to Serve Their Country], Preamble.

⁹关于鼓励海外留学人员以多种形式为国服务的若干意见 [Some Opinions on Encouraging Overseas Scholars to Serve Their Country], Section 2(1-7).

¹⁰"九三学社提案：人才称号过多过滥，建议关闭‘僵尸’人才计划 [Jiu San Society Proposal: Talent titles are too numerous and too excessive, it is recommended to close ‘zombie’ talent plans]," February 28, 2018, accessed June 5, 2022, https://www.sohu.com/a/224599002_260616.

¹¹Strider, "Quantum Dragon: How China Is Exploiting Western Government Funding and Research Institutes to Leapfrog in Dual-Use Quantum Technologies," published November 2019.

¹²"聚天下英才而用之 [Gather the World’s Talents and Use Them]," People’s Daily, September 28, 2021, accessed June 1, 2022, <http://politics.people.com.cn/n1/2021/0928/c1001-32239119.html>.

¹³"哈尔滨工业大学公派联合培养博士研究生选派办法 [Harbin Institute of Technology’s State-Sponsored Joint Cultivation Doctorial Candidate Selection Method]," April 13, 2022, accessed June 1, 2022, <https://hitgs.hit.edu.cn/2022/0414/c3333a271812/pagem.htm>.

¹⁴"哈尔滨工业大学公派出国留学研究生管理办法 (试行) [Measures for the Administration of State-Sponsored Graduate Students of Harbin Institute of Technology (Trial Implementation)]," April 13, 2022, accessed June 1, 2022, <https://hitgs.hit.edu.cn/2022/0414/c3333a271812/pagem.htm>.

¹⁵Toauto, "国家公派研究生项目英文介绍, 清华大学2008年国家公派研究生项目手册-摘 [Introduction to State-Sponsored Postgraduate Programs in English, Tsinghua University 2008 State-Sponsored Postgraduate Program Manual—Excerpt]", accessed June 4, 2022, .

¹⁶Aslanchen, "美国洛斯阿拉莫斯国家实验室功能薄膜材料研究组招收公派联合培养研究生 [Los Alamos National Laboratory Functional Thin Film Materials Research Group Recruits State-Sponsored Graduate Students for Joint Training]," February 12, 2017, accessed June 2, 2022, <http://muchong.com/html/201706/11038429.html>.

¹⁷"Postdoctoral Program at Los Alamos National Laboratory," Los Alamos National Laboratory, accessed June 2, 2022, https://www.lanl.gov/careers/career-options/postdoctoral-research/_assets/docs/postdoc-program-brochure.pdf.

¹⁸"Board of Regents Briefing Paper," Nevada System of Higher Education, June 3, 2010, accessed June 3, 2022, <https://nshe.nevada.edu/tasks/sites/Nshe/assets/File/BoardOfRegents/Agendas/10/jun/Board/BOR-19.pdf>.

¹⁹For examples of MSS engagement with PRC study-abroad programs, see "泸州市国安局到我校了解对外交流学生情况 [Luzhou Municipal Ministry of State Security came to our school to understand the situation of foreign exchange students], May 28, 2015, accessed June 5, 2022, <http://www.lzljtfzx.com/content/1456.html>; "国际教育与交流中心 [International Education and Exchange Center]," Pingxiang University, accessed June 4 2022, <http://gjzx.pxc.jx.cn/info/1094/1152.htm>; Anastasya Lloyd-Damjanovic and Alex Bowe, "Overseas Chinese Students and Scholars in China's Drive for Innovation," U.S.-China Economic and Security Review Commission, October 7, 2020, https://www.uscc.gov/sites/default/files/2020-10/Overseas_Chinese_Students_and_Scholars_in_Chinas_Drive_for_Innovation.pdf; Nicholas Eftimiades, "China's Ministry of State Security: Coming of Age in the International Arena," University of Maryland School of Law, 1992, p. 15, accessed June 2, 2022, <https://digitalcommons.law.umaryland.edu/cgi/viewcontent.cgi?article=1108&context=mscas>.

²⁰"Threats to the U.S. Research Enterprise: China's Talent Recruitment Plans," United States Senate Permanent Subcommittee on Investigations, accessed June 3, 2022, <https://www.hsgac.senate.gov/imo/media/doc/2019-11-18%20PSI%20Staff%20Report%20-%20China's%20Talent%20Recruitment%20Plans%20Updated2.pdf>.

²¹See Supreme Judicial Court of Massachusetts, Lieber v. President & Fellows of Harvard Coll., No. SJC-13141, January 10, 2022, accessed June 1, 2022, <https://casetext.com/case/lieber-v-president-fellows-of-harvard-coll-1>; "Threats to the U.S. Research Enterprise: China's Talent Recruitment Plans," United States Senate Permanent Subcommittee on Investigations, p. 73, accessed June 7, 2022, <https://www.hsgac.senate.gov/imo/media/doc/2019-11-18%20PSI%20Staff%20Report%20-%20China's%20Talent%20Recruitment%20Plans.pdf>.

²²"The Distinguished Researcher Ma Jianxing of Shanghai Institute of Materia Medica was hired as an Overseas Review Expert of the Chinese Academy of Sciences," Shanghai Institute of Materia Medica, Chinese Academy of Sciences, July 2, 2015, accessed June 4, 2022, http://english.simm.cas.cn/News/Np/202011/t20201127_253738.html.

²³"中国科学院增聘"海外评审专家" [Chinese Academy of Sciences Recruits 'Overseas Review Experts'], accessed June 6, 2022, <http://www.networkchinese.com/region/china/hutasia.html>.

²⁴Hepeng Jia, "What is China's Thousand Talents Plan?" Nature Career Guide, January 17, 2018, accessed June 4, 2022, <https://media.nature.com/original/magazine-assets/d41586-018-00538-z/d41586-018-00538-z.pdf>.

²⁵"青年千人计划",海外青年学子归国最佳之选! ['Youth Thousand Talents Program', the best choice for overseas young students to return home!], Consulate General of the People's Republic of China in Munich, April 1, 2015, accessed June 10, 2022, <https://www.mfa.gov.cn/ce/cgmu/chn/jy/jy3/t1251144.htm>.

²⁶Given that individuals can be selectees of multiple talent programs, we associate each selectee with the highest-level talent program into which they were selected into closest to their recorded return date to the PRC.

²⁷"Threats to the U.S. Research Enterprise: China's Talent Recruitment Plans," United States Senate Permanent Subcommittee on Investigations, accessed June 7, 2022, <https://www.hsgac.senate.gov/imo/media/doc/2019-11-18%20PSI%20Staff%20Report%20-%20China's%20Talent%20Recruitment%20Plans.pdf>.

²⁸“Department of Energy Foreign Government Talent Recruitment Programs,” U.S. Department of Energy, June 7, 2019, accessed June 7, 2022, <https://www.energy.gov/sites/default/files/2019/06/f63/DOE%200%20486.1.pdf>.

²⁹Stephen Chen, “America’s Hidden Role in Chinese Weapons Research,” South China Morning Post, March 29, 2017, accessed May 31, 2022, <https://www.scmp.com/news/china/diplomacy-defence/article/2082738/americas-hidden-role-chinese-weapons-research>.

³⁰“Distinguished Postdoc Fellows Past and Present,” Los Alamos National Laboratory, May 2014, accessed June 1, 2022, https://lanl.gov/careers/career-options/postdoctoral-research/_assets/docs/all-dist-may14.pdf. <https://app.box.com/s/qe6t9ixuencnrexc0yff4d5wn46rkz0v>.

³¹“CHEN Shiyi,” Southern University of Science and Technology, accessed June 3, 2022, <https://faculty.sustech.edu.cn/chensy/en/>; See also “Shiyi Chen, PhD,” Elsevier, accessed June 2, 2022, <https://www.journals.elsevier.com/sustainable-horizons/editorial-board/shiyi-chen-phd>.

³²“President Chen Elected as Shenzhen ‘Talent Ambassador,’ ” Southern University of Science and Technology School of Life Sciences, November 2, 2017, accessed June 10, 2022, <https://bio.sustech.edu.cn/news/detail/938.html?lang=en-us>.

³³“陈十一 [Chen Shiyi],” Southern University of Science and Technology, accessed June 11, 2022, <https://faculty.sustech.edu.cn/chensy/>; Chen was still identified as director of LTCS in December 2019, see “湍流与复杂系统国家重点实验室 (LTCS) 与非线性力学国家重点实验室 (LNM) 2019联合学术年会成功召开 [The 2019 Joint Academic Annual Conference of the State Key Laboratory of Turbulence and Complex Systems (LTCS) and the State Key Laboratory of Nonlinear Mechanics (LNM) was successfully held],” 北京大学湍流与复杂系统国家重点实验室 [State Key Laboratory for Turbulence & Complex Systems], December 27, 2019, accessed June 1, 2022, <https://ltcs.pku.edu.cn/xwl/tz/919995.html>; Chen was still identified as director of LTCS in December 2019. By late-2020, his deputy Li Cunbiao (李存标) had taken up the directorship. See “‘水蚀到烧蚀’的一次优雅碰撞 –记纽约大学张骏教授学术报告 [An elegant collision of ‘water erosion to ablation’ -- an academic report of Professor Zhang Jun from New York University],” 北京大学湍流与复杂系统国家重点实验室 [State Key Laboratory for Turbulence & Complex Systems], September 23, 2020, accessed June 2, 2022.

³⁴“学术委员会 [Academic Committee],” 北京大学湍流与复杂系统国家重点实验室 [State Key Laboratory for Turbulence & Complex Systems], accessed June 10, 2022, <https://ltcs.pku.edu.cn/sysgk/xzwyk/index.html>.

³⁵Stephen Chen, “America’s Hidden Role in Chinese Weapons Research,” South China Morning Post, March 29, 2017, accessed May 31, 2022, <https://www.scmp.com/news/china/diplomacy-defence/article/2082738/americas-hidden-role-chinese-weapons-research>.

³⁶“高超声速静风洞的研制与流动测量技术的发展 [Development of Hypersonic Quiet Wind Tunnel and Development of Flow Measurement Technology],” 北京大学湍流与复杂系统国家重点实验室 [State Key Laboratory for Turbulence & Complex Systems], March 26, 2022, accessed June 14, 2022, <https://ltcs.pku.edu.cn/kxyj/kycg/dbxcg/225069.html>.

³⁷“Φ120mm高超声速静风洞 [Φ120mm Hypersonic Quiet Wind Tunnel],” accessed June 17, 2022, <https://www.lab.pku.edu.cn/docs/20140422202556066080.pdf>; Cunbiao Lee and Shiyi Chen, “Recent Progress in the Study of Transition in the Hypersonic Boundary Layer,” National Science Review, May 7, 2018, accessed June 14, 2022, <https://europemc.org/backend/ptpmcrender.fcgi?accid=PMC8291524&blobtype=pdf>.

³⁸A quiet tunnel is so called because it is capable of flowing air at hypersonic velocities without the “noise” created by the turbulent boundary layer that develops at such speeds. See Eric Tegler, “To Develop Hypersonic Weapons, The U.S. Has To Build Some Fiendishly Complicated Wind Tunnels,” Forbes, June 19, 2020, accessed June 16, 2022, <https://www.forbes.com/sites/erictegler/2020/06/19/to-develop-hypersonic-weapons-the-us-has-to-build-some-fiendishly-complicated-wind-tunnels/?sh=66961513237e>.

³⁹“高超声速静风洞的研制与流动测量技术的发展 [Development of Hypersonic Quiet Wind Tunnel and Development of Flow Measurement Technology],” State Key Laboratory for Turbulence & Complex Systems, March 26, 2010, accessed June 18, 2022, <https://ltcs.pku.edu.cn/kxyj/kycg/dbxcg/225069.html>.

⁴⁰“高超声速静风洞实验室 [Hypersonic Quiet Wind Tunnel Laboratory],” 北京大学昌平新校区管委会 [Peking University Changping New Campus Management Committee], accessed June 11, 2022, <https://www.cpc.pku.edu.cn/kyfw/zcsys/gxy/931616.htm>.

⁴¹“973项目专栏 [Project 973 Column],” 北京大学湍流与复杂系统国家重点实验室 [State Key Laboratory for Turbulence & Complex Systems], accessed June 11, 2022, <https://ltcs.pku.edu.cn/ksdh/zdxmzl/index.html>.

⁴²“第二届爆轰与爆震发动机研讨会 [2nd Symposium on Detonation and Detonation Engines],” 中国力学学会 [The Chinese Society of Theoretical and Applied Mechanics], February 7, 2013, accessed June 20, 2022, <http://www.cstam.org.cn:81/article/169885.html>.

⁴³“湍流与复杂系统国家重点实验室访问航天三院 探讨国家重点实验室联合共建 [State Key Laboratory for Turbulence and Complex Systems Visits China Aerospace Science and Industry Corporation Third Academy to Discuss the Joint Construction of State Key Laboratories], State Key Laboratory for Turbulence and Complex Systems, September 9, 2020, accessed June 1, 2022, <https://ltcs.pku.edu.cn/xwl/tz/922609.html>.

⁴⁴“空气动力学国家重点实验室组织召开 学术委员会工作会议 [The State Key Laboratory of Aerodynamics Organized a Working Meeting of the Academic Committee],” 中国空气动力研究与发展中心 [China Aerodynamics Research and Development Center], March 31, 2020, accessed June 23, 2022, http://www.cardc.cn/news_read.asp?ChannelId=2&ClassId=5&Id=144.

⁴⁵“China Aerodynamics Research and Development Center,” Australian Strategic Policy Institute China Defence Universities Tracker, accessed June 20, 2022, <https://unitracker.aspi.org.au/universities/china-aerodynamics-research-and-development-center/>.

⁴⁶See 吴继飞 [Wu Jifei] et al., “内埋弹舱舱门气动特性研究 [Investigation on Aerodynamic Characteristics of Internal Bay's Door],” 空气动力学学报 [Chinese Journal of Aerodynamics], 2012, accessed June 1, 2022, http://journal16.magtechjournal.com/Jweb_aas/CN/abstract/abstract11223.shtml and 何开锋 [He Kaifeng] et al., “先进战斗机过失速机动模型飞行试验技术 [Model Flight Test Technology for Post-Stall Maneuver of Advanced Fighter],” 空气动力学学报 [Chinese Journal of Aerodynamics], 2020, accessed June 23, 2022, <http://kqdlxxb.xml-journal.net/cn/article/doi/10.7638/kqdlxxb-2019.0088?viewType=HTML>.

⁴⁷“China Aerodynamics Research and Development Center,” Australian Strategic Policy Institute China Defence Universities Tracker, accessed June 20, 2022, <https://unitracker.aspi.org.au/universities/china-aerodynamics-research-and-development-center>. Error! Hyperlink reference not valid.

⁴⁸“国家自然科学基金重大研究计划管理办法 [Measures for the Administration of Major Research Programs of the National Natural Science Foundation of China],” 国家自然科学基金委员会 [National Natural Science Foundation of China], May 12, 2015, accessed June 14, 2022, <https://www.nsfc.gov.cn/publish/portal0/tab475/info70228.htm>.

⁴⁹“国家自然科学基金重大研究计划“面向发动机的湍流燃烧基础研究”简介 [Introduction to the National Natural Science Foundation of China Major Research Program “Basic Research on Turbulent Combustion for Engines”],” 实验流体力学 [Journal of Experiments in Fluid Mechanics], March 2022, accessed June 23, 2022, <http://www.syltlx.com/cn/topic?id=3c5e939a-fff6-4aca-af99-edebæ584900>.

⁵⁰“项目介绍 [Project Introduction],” 中国空气动力研究与发展中心吸气式高超声速技术研究中心 [China Aerodynamic Research and Development Center Air-breathing Hypersonic Technology Research Center],” accessed June 14, 2022, <http://www.cardc.cn/gaochao/html/Project/>.

⁵¹刘涛 [Liu Tao] and 纪军 [Ji Jun], “面向发动机的湍流燃烧基础研究”重大研究计划 2016年度项目进展交流会在成都召开 [Major Research Program ‘Basic Research on Turbulent Combustion for Engines’ 2016 Annual Project Progress Exchange Meeting Was Held in Chengdu],” 国家自然科学基金委员会 [National Natural Science Foundation of China], March 21, 2017, accessed June 23, 2022, <https://www.nsfc.gov.cn/publish/portal0/tab445/info66169.htm>.

⁵²“项目介绍 [Project Introduction],” 中国空气动力研究与发展中心吸气式高超声速技术研究中心 [China Aerodynamic Research and Development Center Air-breathing Hypersonic Technology Research Center],” accessed June 14, 2022, <http://www.cardc.cn/gaochao/html/Project/>.

⁵³单肖文-南方科技大学-发动机条件下燃烧对湍流全尺度影响的机理研究 [Shan Xiaowen-Southern University of Science and Technology-Mechanism of Full-Scale Effects of Combustion on Turbulence Under Engine Conditions],” 中国空气动力研究与发展中心吸气式高超声速技术研究中心 [China Aerodynamic Research and Development Center Air-breathing Hypersonic Technology Research Center], February 2, 2022, accessed June 22, 2022, <http://www.cardc.cn/gaochao/html/Project/2017/201802/8Qe6La2Hs6Cm63152.html>.

⁵⁴“Tenure upon Hire and Approval for Starting Salary Above Salary Schedule Maximum—UNLV,” Board of Regents Briefing Paper, June 4, 2010, accessed June 11, 2022, <https://nshe.nevada.edu/tasks/sites/Nshe/assets/File/BoardOfRegents/Agendas/10/jun/Board/BOR-19.pdf>.

⁵⁵“Tenure upon Hire and Approval for Starting Salary Above Salary Schedule Maximum—UNLV,” Board of Regents Briefing Paper, June 4, 2010, accessed June 11, 2022, <https://system.nevada.edu/tasks/sites/Nshe/assets/File/BoardOfRegents/Agendas/10/jun/Board/BOR-19.pdf>.

⁵⁶“Tenure upon Hire and Approval for Starting Salary above Salary Schedule Maximum—UNLV,” Board of Regents Briefing Paper, June 4, 2010, accessed June 11, 2022, <https://nshe.nevada.edu/tasks/sites/Nshe/assets/File/BoardOfRegents/Agendas/10/jun/Board/BOR-19.pdf>.

⁵⁷Dan Michalski, “Powered by Discovery: UNLV’s Advanced Energy Research Team Is Changing Batteries from the Inside Out,” University of Nevada, Las Vegas, December 1, 2015, accessed June 17, 2022, <https://www.unlv.edu/news/article/powerd-discovery>.

⁵⁸“Zhao Yusheng,” Southern University of Science and Technology Faculty, accessed June 1, 2022, <https://faculty.sustech.edu.cn/zhaoy/en/>.

⁵⁹Russell J. Hemley, et al., “Year Two Annual Report,” Carnegie/DOE Alliance Center, September 2005, accessed June 13, 2022, <https://cdac.carnegiescience.edu/sites/default/files/Report%20website.pdf>.

⁶⁰Yusheng Zhao, “Why Robust Deep-Earth-Penetrating Weapons?” Nuclear Weapons Journal, 2004, accessed June 2, 2022, <https://www.lanl.gov/orgs/padwp/pdfs/7nwj1-04.pdf>.

⁶¹Eric Canuteson, et al., “Superhard, Ultratough Nanocomposites,” Los Alamos National Laboratory, accessed June 10, 2022, <https://corpora.tika.apache.org/base/docs/govdocs1/002/002369.pdf>.

⁶²“贺端威 教授 [Professor He Duanwei],” 四川大学原子与分子物理研究所 [Institute of Atomic and Molecular Physics], Sichuan University, accessed June 20, 2022, <http://iamp.scu.edu.cn/jsyjy/201806/148.html>.

⁶³The authors thank CAEP scientist 毕延 (Bi Yan) for valuable assistance during the course of their research. See 许超 [Xu Chao], et al., “纳米聚晶金刚石的高压高温合成 [High Pressure and High Temperature Synthesis of Nano-Polycrystalline Diamond],” August 2011, accessed June 21, 2022, <https://www.wdfxw.net/doc10310326.htm>.

⁶⁴“毕延 [Bi Yan],” accessed June 19, 2022, <http://a.xueshu.baidu.com/scholarID/CN-B475A9UJ>.

⁶⁵PRC defense laboratories often obfuscate their defense ties by omitting the word “national defense” from their official English-language names: “含能材料的相变 [Phase Transitions of Energetic Materials],” 爆炸科学与技术国家重点实验室 [State Key Laboratory of Explosion Science and Technology], September 28, 2017, accessed June 7, 2022, <https://est.bit.edu.cn/xzyg/b106897.htm>.

⁶⁶“贺端威 教授 [Professor He Duanwei],” [Institute of Atomic and Molecular Physics], Sichuan University, accessed June 20, 2022, <http://iamp.scu.edu.cn/jsyjy/201806/148.html>.

⁶⁷“转物理学院：校党委书记王建国同志一行来我院调研座谈 [Transfer to the School of Physics: Comrade Wang Jianguo, Secretary of the Party Committee of the School, and His Party Came to our School for Investigation and Discussion],” 四川大学原子核科学技术研究所 [Institute of Nuclear Science and Technology, Sichuan University], April 22, 2019, accessed June 3, 2022, <https://720inst.scu.edu.cn/News/info?cid=2633&id=60&mid=60>; “实验室简介 [Laboratory Introduction],” 高能量密度物理及技术教育部重点实验室 [Key Laboratory of High Energy Density Physics and Technology], accessed June 12, 2022, <http://www.csjiaze-hsca.com/lhdp/sysjj.html>.

⁶⁸“无人机应用市场 [UAV Application Market],” 智能航空技术研究中心 [Intelligent Aviation Technology Research Center], accessed June 15, 2022, <https://www.sustechtz.com/h5/hkzx/market1.html>.

⁶⁹“台州“无中生有”打造出全新的产业集群 蓄势待发 [Taizhou “Creates Something Out of Nothing” to Create a New Industrial Cluster Ready to Go],” 台州新闻 [Taizhou News], September 2, 2021, accessed June 22, 2022, https://tz.zjol.com.cn/tzxw/202109/t20210901_23029993.shtml.

⁷⁰Shiyi Chen, et al., “Lattice Boltzmann Computational Fluid Dynamics in Three Dimensions,” Journal of Statistical Physics, August 1992, accessed June 2, 2022, <https://link.springer.com/article/10.1007/BF01341754>.

⁷¹D.C. Montgomery, “Nonlinear Magnetohydrodynamics. Progress report, July 1, 1993–June 30, 1994,” U.S. Department of Energy, 1994, accessed June 2, 2022, <https://www.osti.gov/servlets/purl/10173057>.

⁷²“Shan Xiaowen,” Southern University of Science and Technology, accessed June 21, 2022, <https://faculty.sustech.edu.cn/shanxw/en/>.

⁷³鱼羊 [Yu Yang], “陈十一院士旗下国产CAE软件开发商获数亿元融资，产品技术已有应用成果 [Academician Chen Shiyi’s Domestic CAE Software Developer Has Received Hundreds of Millions in Financing, and the Product Technology Has Been Applied],” March 10, 2022, accessed June 13, 2022, <https://www.qbitai.com/2022/03/33229.html>.

⁷⁴Original tender notice: “热流场仿真分析软件升级招标公告 [Heat Flow Field Simulation Analysis Software Upgrade Tender Announcement],” 中国航空工业集团有限公司 [Aviation Industry Corporation of China Limited], December 2, 2021, accessed June 12, 2022, <https://ebid.eavic.com/cms/channel/ywgg1hw/84584.htm>; Tender results: “热流场仿真分析软件升级中标候选人公示 [Announcement of Winning Bidders for Heat Flow Field Simulation Analysis Software Upgrade],” 中国航空工业集团有限公司 [Aviation Industry Corporation of China Limited], December 27, 2021, accessed June 12, 2022, <https://ebid.eavic.com/cms/channel/ywgg3hw/85346.htm>.

⁷⁵“关于十沣 [About Tenfong],” accessed June 14, 2022, https://www.tenfong.cn/about.html#abo_three.

⁷⁶“FlightSim 飞行器可视化设计与仿真平台 [FlightSim Aircraft Visualization Design and Simulation Platform],” 北京友一智能科技有限公司 [Beijing Youyi Intelligent Technology Co., Ltd.], accessed May 31, 2022, <https://www.aicae.cn/FlightSim>; “FlightSim 飞行器弹道设计实战技巧 [FlightSim Aircraft Ballistic Design Practical Skills],” accessed June 1, 2022, <https://m.bookschina.com/8374518.htm>.

⁷⁷“屈崑 [Qu Kun],” 西北工业大学 [Northwestern Polytechnical University], accessed June 1, 2022, <https://teacher.nwpu.edu.cn/kunqu.html>; “蔡晋生 [Cai Jinsheng],” 西北工业大学 [Northwestern Polytechnical University], accessed June 1, 2022, <https://teacher.nwpu.edu.cn/caijinsheng.html>.

⁷⁸“关于十沣 [About Tenfong],” accessed June 14, 2022, https://www.tenfong.cn/about.html#abo_four.

⁷⁹“Historical Perspective,” Center for Nonlinear Studies, accessed June 19, 2022, <https://cnls.lanl.gov/external/History.php>.

⁸⁰“Guowei He’s Research While Affiliated with Los Alamos National Laboratory and Other Places,” ResearchGate, accessed June 20, 2022, <https://www.researchgate.net/scientific-contributions/Guowei-He-7685635>.

⁸¹“何国威[Guowei He],” Institute of Mechanics, Chinese Academy of Sciences, accessed June 1, 2022, http://www.imech.cas.cn/kydwyfc/201806/t20180607_5023674.html.

⁸²Stephen Chen, “America’s Hidden Role in Chinese Weapons Research,” South China Morning Post, March 29, 2017, accessed June 1, 2022, <https://www.scmp.com/news/china/diplomacy-defence/article/2082738/americas-hidden-role-chinese-weapons-research>.

⁸³“2019年力学所“大学生创新实践训练计划”申报通知 [2019 Application Notice for the ‘Innovative Practice Training Program for College Students’ of the Institute of Mechanics],” 中国科学院力学研究所 [Institute of Mechanics, Chinese Academy of Sciences], April 2, 2019, accessed May 31, 2022, http://www.imech.cas.cn/rctp/yjszs/201904/t20190402_5265665.html.

⁸⁴“何琳 [He Lin],” 何梁何利基金 [The Ho Leung Ho Lee Foundation], accessed June 17, 2022, <http://www.hlhl.org.cn/news/findnews/showsub.asp?id=1299>.

⁸⁵These activities are not limited to U.S. national laboratories, or even to the U.S. In early 2022, an investigation by Deutsche Welle found that dozens of PRC researchers sponsored by the German government to study in Germany now conduct military research: Sandra Petersmann, et al., “How a Humboldt Foundation Fellow Joined China’s Military Commission,” Deutsche Welle, May 20, 2022, accessed June 20, 2022, <https://www.dw.com/en/how-a-humboldt-foundation-fellow-joined-chinas-military-commission/a-61858074>.

⁸⁶See “张涵信 [Zhang Hanxin],” 中国力学学会 [Chinese Society of Theoretical and Applied Mechanics], January 1, 2010, accessed June 14, 2022, <https://www.cstam.org.cn/introduce/1246/7339> and “北京大学湍流与复杂系统国家重点实验室召开2006年度学术年会暨学术委员会议 [The State Key Laboratory of Turbulence and Complex Systems, Peking University held the 2006 Annual Academic Conference and Academic Committee Meeting],” 北京大学工学院 [Peking University College of Engineering], December 22, 2006, accessed June 2, 2022, <https://www.coe.pku.edu.cn/newsfocus/fast/4918.html>.

⁸⁷“张涵信院士受聘北京大学兼职教授 [Academician Zhang Hanxin Is Employed as an Adjunct Professor at Peking University],” 北京大学工学院 [Peking University College of Engineering], December 22, 2006, accessed June 25, 2022, <https://www.coe.pku.edu.cn/newsfocus/fast/4919.html>.

⁸⁸In the PLA, “specialized technical officers” (专业技术军官) are one of five active duty officer career tracks in the PLA. Specialized technical officers tend to be concentrated in equipment and R&D-related organizations. See Kevin Pollpeter and Kenneth W. Allen, eds., *The PLA as Organization V2.0*, Defense Group Inc., 2021, pp. 23-24; “张涵信 [Zhang Hanxin],” The Chinese Society of Theoretical and Applied Mechanics, January 1, 2010, accessed June 5, 2022, <https://www.cstam.org.cn/introduce/1246/7339>; 湍流与复杂系统国家重点实验室召开2008年学术委员会议 [The State Key Laboratory of Turbulence and Complex Systems held the 2008 Academic Committee Meeting],” Peking University College of Engineering, January 14, 2009, <https://www.coe.pku.edu.cn/newsfocus/fast/4680.html>; [任玉新] Ren Yuxin, “[怀念空气动力学前辈张涵信先生] In Memory of Aerodynamics Elder Mr. Zhang Hanxin,” [清华大学怀念师友] Tsinghua University in Memory of Teachers and Friends, Winter 2021, pp. 122-124, accessed June 1, 2022, https://www.tsinghua.org.cn/_local/7/7A/F5/5891883B47E65E649887657D1BA_E4726FBF_1F5C35.pdf.

⁸⁹“学术委员会 [Academic Committee], 北京大学湍流与复杂系统国家重点实验室 [State Key Laboratory for Turbulence & Complex Systems], accessed June 10, 2022, <https://ltcs.pku.edu.cn/sysgk/xzwyk/index.html>.

⁹⁰“邓小刚 [Deng Xiaogang],” Baidu Baike, accessed May 23, 2022, <https://baike.baidu.com/item/%E9%82%93%E5%B0%8F%E5%88%9A/10650911>.

⁹¹“邓小刚 [Deng Xiaogang],” Sichuan University College of Computer Science, September 6, 2021, accessed May 30, 2022, <https://cs.scu.edu.cn/info/1249/16117.htm>.

⁹²战忽局编外工作室 [Zhan Hu Bureau Extra-Staff Studio], “风洞将军邓小刚，转岗军科院副院长，为高超音速武器研制贡献巨大 [Wind tunnel general Deng Xiaogang, who switched posts to become Academy of Military Sciences Vice President, made great contributions to the development of hypersonic weapons],” May 8, 2020, accessed June 1, 2022, <https://www.163.com/dy/article/FC4L8EHN0535CD6Z.html>

⁹³战忽局编外工作室 [Zhan Hu Bureau Extra-Staff Studio], “风洞将军邓小刚，转岗军科院副院长，为高超音速武器研制贡献巨大 [Wind tunnel general Deng Xiaogang, who switched posts to become Academy of Military Sciences Vice President, made great contributions to the development of hypersonic weapons],” May 8, 2020, accessed June 1, 2022, <https://www.163.com/dy/article/FC4L8EHN0535CD6Z.html>

⁹⁴“国家自然科学基金重大研究计划管理办法 [Measures for the Administration of Major Research Programs of the National Natural Science Foundation of China],” National Natural Science Foundation of China, May 12, 2015, accessed June 2, 2022, <https://www.nsfc.gov.cn/publish/portal0/tab475/info70228.htm>.

⁹⁵“数理科学部公布重大研究计划项目评审专家名单 [The Mathematical and Physical Sciences Department announces the list of review experts for major research projects],” October 10, 2021, accessed June 4, 2022, <https://news.scienenet.cn/htmlnews/2021/10/466834.shtm>.

⁹⁶“第十六届中国青年科技奖特别奖获奖者：孙明波 [The 16th China Youth Science and Technology Award Special Award Winner: Sun Mingbo],”中国科协培训和人才服务中心 [CAST Center for Professional Training and Services], April 1, 2022, <https://mrczx.cast.org.cn/index/article/id/392>.

⁹⁷“重大研究计划“面向发动机的湍流燃烧基础研究”项目启动会在绵阳召开 [The Kick-off Meeting of the Major Research Program Basic Research on Turbulent Combustion for Engines' was held in Mianyang],”中国空气动力研究与发展中心吸气式高超声速技术研究中心 [China Aerodynamic Research and Development Center Air-breathing Hypersonic Technology Research Center], March 26, 2015, accessed June 22, 2022, <http://www.cardc.cn/gaochao/html/News/201503/3Pp3Rd7By2Xw33183.html>.

⁹⁸“甘晓华 [Gan Xiaohua],” Chinese Academy of Engineering, accessed June 1, 2022, <https://www.cae.cn/cae/html/main/colys/71311121.html>.

⁹⁹Shu Shan [书山], “俄称中国歼-20达不到5代机标准只能算4代半(图)[Russian claims that China's J-20 can only be counted as a four and a half generation if it can't reach the fifth generation standard],” Sina.com, January 25, 2011, accessed June 3, 2022, <http://mil.news.sina.com.cn/2011-01-25/0950629811.html>; “湍流与复杂系统国家重点实验室2013年度学术年会暨学术委员会会议在北京大学召开[The 2013 Annual Academic Conference and Academic Committee Meeting of the State Key Laboratory of Turbulence and Complex Systems was held at Peking University],” State Key Laboratory of Turbulence and Complex Systems, January 23, 2014, <https://ltcs.pku.edu.cn/xwl/tz/910547.html>.

¹⁰⁰“习主席在视察军事科学院时的重要讲话在全军和武警部队引起强烈反响 [Chairman Xi's important speech during his inspection of the Academy of Military Sciences caused a strong reaction from whole military and the armed police force],” May 17, 2018, <http://news.haiwainet.cn/n/2018/0517/c3543307-31318297.html>.

¹⁰¹“周玉院士牵头的国家自然科学基金委创新研究群体再获延续资助_哈尔滨工业大学 [The innovation research group of the National Natural Science Foundation of China led by Academician Zhou Yu has received renewed funding_Harbin Institute of Technology],” FreeKaoYan.com, accessed June 4, 2022, <http://school.freekaoyan.com/heilongjiang/hit/dongtai/2018/04-10/1523339429787623.shtml>.

¹⁰²“Xu Ping [徐平],” Harbin Institute of Technology, updated July 28, 2022, accessed June 1, 2022, <http://homepage.hit.edu.cn/pingxu>.

¹⁰³“Home,” Ping Xu @ Harbin Institute of Technology, September 20, 2011, <https://pingxu.weebly.com/>; “Xu Ping [徐平],” Harbin Institute of Technology, updated July 28, 2022, accessed June 1, 2022, <http://homepage.hit.edu.cn/pingxu>.

¹⁰⁴“Wang Hsinglin,” Southern University of Science and Technology, accessed June 1, 2022, <https://faculty.sustech.edu.cn/wangxl3/en/>.

¹⁰⁵"Hsing-lin Wang," Journal of Materials Science and Nanotechnology, accessed June 1, 2022, <http://www.annexpublishers.co/editorial-board/member/460/HSING-LIN-WANG-Journal-of-Materials-Science-and-Nanotechnology/>.

¹⁰⁶"Wang Hsinglin," Southern University of Science and Technology, accessed June 1, 2022, <https://faculty.sustech.edu.cn/wangxl3/en/>.

¹⁰⁷Ibid.

¹⁰⁸"中国船舶力学与船舶工程专家吴有生院士做客我校名家讲坛 [Academician Wu Yousheng, an Expert in Mechanics and Ship Engineering from the China State Shipbuilding Corporation, was a Guest at our School's Famous Expert Forum], <https://www.just.edu.cn/news/2020/0831/c8158a268644/page.htm>" Jiangsu University of Science and Technology, August 31, 2020, accessed June 2, 2022, <https://www.just.edu.cn/news/2020/0831/c8158a268644/page.htm>.

¹⁰⁹"邱志明 [Qiu Zhiming]," Chinese Academy of Engineering, accessed June 2, 2022, <https://www.cae.cn/cae/html/main/colys/80521618.html>.

¹¹⁰"朱英富 [Zhu Yingfu]," Shanghai Jiao Tong University School of Naval Architecture, Ocean & Civil Engineering, accessed June 1, 2022, https://naoce.sjtu.edu.cn/xz_sy/5173.html.

¹¹¹"[杨德森]Yang Desen," X-MOL, accessed May 30, 2022, <https://www.x-mol.com/university/faculty/300719>.

¹¹²"海洋工程重大力学问题 [Major Problems in Mechanics in Marine Engineering]," State Key Laboratory of Ocean Engineering, accessed June 1, 2022, <https://oe.sjtu.edu.cn/list.php?id=3&t=1>.

¹¹³"海洋工程重大力学问题 [Major Problems in Mechanics in Marine Engineering]," State Key Laboratory of Ocean Engineering, accessed June 1, 2022, <https://oe.sjtu.edu.cn/list.php?id=3&t=1>.