

## CHAPTER ONE

# Under the Radar: National Security Risk in US-China Scientific Collaboration

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### I. Introduction

The rise of the People's Republic of China (PRC) as a major economic and military power has sparked serious national security concerns in the United States, particularly in response to the PRC's active development of force projection capabilities, its intensification of domestic surveillance, widespread human rights abuses, unfair trade practices, forced technology transfer, state-sponsored industrial espionage, and intellectual property (IP) theft.<sup>1</sup> Alarm also stems from the PRC's stated intention to dominate strategic technologies and industries and its poor transparency with respect to governance.<sup>2</sup>

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1. Senator Mark Warner surveyed the range of threats China poses to US national and economic security in a speech at a Brookings Institution event, Global China: Assessing China's Growing Role in the World, May 19, 2019, <http://www.brookings.edu/events/global-china-assessing-chinas-growing-role-in-the-world>.
2. A suggested sampling of materials that examine these issues include: a) William C. Hannas, James C. Mulvenon, and Anna P. Puglisi, *Chinese Industrial Espionage* (London and New York: Routledge 2013); b) Michael Brown and Pavneet Singh,

Many of these concerns intersect with the PRC's access to and influence within the US research community, especially in universities and US national laboratories. These intersections include the following:

- The increasing number of unclassified research areas and technologies with potential military applications, which complicates US government oversight and regulation (e.g., through export controls).
- PRC state-run talent recruitment programs that harvest US research.
- Unreported or misreported research collaborations, which can distort resource allocation and raise research integrity concerns.
- Inadequate compliance, monitoring, and due diligence by US research institutions with respect to research collaborations and enforcement of ethics and conflict of interest and commitment rules.
- The absence of any comprehensive or empirical study of research collaborations in science and technology (S&T) between PRC and US institutions to identify and assess potential risks.

American universities are among the best in the world, and their S&T research programs attract a highly talented, global pool of applicants. There is no question that the openness of the US research system

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“China’s Technology Transfer Strategy: How Chinese Investments in Emerging Technology Enable A Strategic Competitor to Access the Crown Jewels of U.S. Innovation,” Defense Innovation Unit Experimental January 2018; c) Office of the US Trade Representative, Executive Office of the President, “Findings of the Investigation into China’s Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation under Section 301 of the Trade Act of 1974,” March 22, 2018; d) National Bureau of Asian Research, “The Report of the Commission on the Theft of American Intellectual Property,” May 2013; e) Committee on the Judiciary, US Senate, “China’s Non-Traditional Espionage Against the United States: The Threat and Potential Policy Responses,” December 12, 2018; f) Larry Diamond and Orville Schell, eds., “China’s Influence and American Interests, Promoting Constructive Vigilance” (Stanford, CA: Hoover Institution Press, 2019); g) U.S.-China Economic and Security Review Commission, “China’s Overseas United Front Work: Background and Implications for the United States,” August 24, 2018; h) Levesque, Stokes, “Blurred Lines: Military-Civil Fusion and the ‘Going Out’ of China’s Defense Industry,” Pointe Bello report, December 2016.

has contributed to US economic, technological, and military superiority for decades. In fact, since the US government established official diplomatic relations with the PRC, it has facilitated and encouraged collaboration with PRC-based researchers and institutions as matters of policy and soft power diplomacy.<sup>3</sup>

Meanwhile, the PRC's S&T ambitions have mushroomed. Guided by the concept of military-civil fusion, the PRC is resolutely integrating private sector innovation into its defense industrial base, in part by tapping the capabilities of ostensibly civilian domestic institutions. Some of these institutions participate in a coordinated, state-directed technology transfer apparatus that is tasked with obtaining, commercializing, and weaponizing advanced foreign R&D. Only now is the US research community awakening to the intensity and scope of this enterprise and its military or dual-use dimensions. However, in the absence of external regulatory or policy mandates, US research institutions have been slow to adapt their due diligence and risk management frameworks. Weak institutional reporting mechanisms and compliance cultures have permitted some collaborations to go unknown, unreported, or underreported.<sup>4</sup> Even among vetted collaborations, conflicts of commitment, unreported or misreported elements, or other activities that undermine the integrity of US scientific research and exceed the scope of collaboration agreements occur. In short, prevailing due diligence and risk management practices for screening and tracking potential collaborations with PRC entities fall far short of what circumstances require.

The director of the National Institutes of Health (NIH) highlighted these gaps in a 2018 letter addressed to more than ten thousand institutions in which he expressed concern that some recipients of NIH

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3. For an overview of the history of scientific collaboration with China and US policies that fostered much of this collaboration, see Richard P. Suttmeier, "Trends in U.S.-China Science & Technology Cooperation: Collaborative Knowledge Production for the Twenty-First Century?," Research Report Prepared on Behalf of the U.S.-China Economic and Security Review Commission, September 11, 2014.

4. Note that federal funding agencies have different requirements regarding disclosure of foreign collaborations and additional sources of funding; as such not all collaboration may have to be reported.

research funding had diverted IP in grant applications or from NIH-funded research to other countries; shared confidential grant application information with others, including foreign entities, or attempted to influence funding decisions; and failed to disclose substantial resources from foreign governments, thereby distorting decisions about the appropriate use of NIH funds.<sup>5</sup> The terminations of three ethnic Chinese scientists at the MD Anderson Cancer Center and two Emory University professors were related to these concerns.<sup>6</sup> The arrest of Professor Charles Lieber, chair of the Chemistry and Chemical Biology department at Harvard University, arose from them as well.<sup>7</sup>

Given the paucity of available data, we cannot determine if such cases are outliers. But we can say that the fragmentary way in which US policymakers and the research community generally assess the risks posed by PRC students, researchers, and collaborative exchanges is seriously flawed. Fundamentally, that assessment has hinged on the *legality* of an activity; i.e., if no US laws will be violated, then the hazards are assumed to be negligible, or perhaps manageable. This crude binary test and the law enforcement paradigm behind it are poorly suited to the spectrum of potential risks revealed by this chapter, to say nothing of the crimes of gravest concern—economic espionage and intellectual property theft

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5. Francis S. Collins, “NIH Foreign Influence Letter to Grantees,” official memorandum, Department of Health and Human Services, Bethesda, MD, August 20, 2018, [https://doresearch.stanford.edu/sites/default/files/documents/nih\\_foreign\\_influence\\_letter\\_to\\_grantees\\_08-20-18.pdf](https://doresearch.stanford.edu/sites/default/files/documents/nih_foreign_influence_letter_to_grantees_08-20-18.pdf).

6. Todd Ackerman, “MD Anderson Ousts 3 Scientists over Concerns about Chinese Conflicts of Interest,” *Houston Chronicle*, April 19, 2019, <https://www.houstonchronicle.com/news/houston-texas/houston/article/MD-Anderson-fires-3-scientists-over-concerns-13780570.php>; Ariel Hart, “New Findings: 2 Emory Researchers Didn’t Disclose Chinese Funding, Ties,” *Atlanta Journal-Constitution*, May 23, 2019, <https://www.ajc.com/news/state--regional-govt-politics/new-findings-emory-researchers-didn-disclose-chinese-funding-ties/QQ58XiznSIIiTLYv5rARfjL>.

7. US Department of Justice, “Harvard University Professor and Two Chinese Nationals Charged in Three Separate China Related Cases,” Justice News, January 28, 2020, <https://www.justice.gov/opa/pr/harvard-university-professor-and-two-chinese-nationals-charged-three-separate-china-related>.

(18 U.S.C. § 1831,1832)—which can be exceptionally difficult to prove in academic research contexts. Perfecting or intensifying the implementation of this paradigm will therefore reap only limited gains.

Presidential Proclamation 10043 of May 29, 2020 does not substantially alter that. The proclamation directs the US secretary of state to deny F or J visas to study or conduct research in the United States to any postgraduate student or researcher from the PRC “who either receives funding from or who currently is employed by, studies at, or conducts research at or on behalf of, or has been employed by, studied at, or conducted research at or on behalf of, an entity in the PRC that implements or supports the PRC’s ‘military-civil fusion strategy.’”<sup>8</sup>

Effective implementation of the proclamation will narrow some of the channels through which the collaborations analyzed in this chapter have transpired, but it will not close them. For instance, collaborations with US partners may move online or to sites outside of the United States. The PRC government is highly disciplined and adaptive and will foreseeably seek ways to ensure that PRC students and researchers who pose security risks to the United States will continue to receive visas. It may, for example, work through entities that lie beyond the scope of the proclamation’s application, always endeavoring, as it does now, to stay one step ahead.

This chapter documents cases of PRC entities, students, and researchers obfuscating or misrepresenting their identities. US consular officials may fail to discern such subterfuge in a visa applicant’s background or connect the applicant’s declared program of study to sensitive fields of knowledge or dual-use technologies, which means that the hardest cases to detect may still get through. It is incumbent on research institutions to develop the tools to distinguish these individuals and any activities that they may undertake that are prejudicial to the interests of the United States from the general population of PRC students and researchers who pose no security risks. If research institutions fail, then more prescriptive regulatory solutions will be waiting in the wings.

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8. US President, “Proclamation 10043 of May 29, 2020.”

### *A. Assessing the Risks of Research Collaboration*

*Academic institutions must adopt proactive risk management and due diligence frameworks in order to more fully meet the challenges that collaborations with the PRC pose to the US research and innovation ecosystem.* These challenges implicate fundamental norms of research and academic integrity, ethics, and administrative rules (as opposed to criminal statutes), and they intersect with potential national and economic security threats. These threats include the following:

- Conversion of US government-funded research into intellectual property that is then commercialized in the PRC in violation of research grant or university terms and conditions.
- Direction or redirection of US research to the PRC government by selectees of the PRC's state-run talent recruitment programs.
- Improper PRC influence over, or manipulation of, US research grant evaluations and award decisions.
- Diversions of US research to PRC defense programs and weapons system development, which can undermine or eliminate US military superiority.
- Diversions of US research to applications that violate ethical standards or democratic norms and values, such as those that enable or enhance the PRC's domestic surveillance apparatus and human rights abuses.
- Failing to report or misreporting foreign affiliations, research projects, and additional sources of funding, in violation of federal research grant disclosure rules.

Moreover, these new frameworks must be evidence based and reflect the empirical state of R&D collaboration between the two nations. US collaboration with defense-affiliated institutions, scientists, and engineers in the PRC is a key vector through which the PRC obtains access to US R&D with national and economic security implications. Unfortunately, scholarship on this subject is sparse and grounded mostly in surveys of English-language publications aggregated by Elsevier, Web

of Science, Scopus, or other international publication databases. Even so, a seminal 2018 study by the Australian Strategic Policy Institute (ASPI) estimates that the People's Liberation Army (PLA) has sent more than 2,500 military scientists and engineers overseas to collaborate with researchers and institutions worldwide. The US is one of the top destinations for those personnel.<sup>9</sup> A subsequent ASPI study identified 115 PRC research institutions that pose “high” or “very high” risks to potential Western partners. The identified PRC institutions support the PLA, defense R&D, the major defense conglomerates, and/or the PRC's intelligence and security apparatus.<sup>10</sup>

These ASPI studies have shed critical light on the scale of the PRC military's exploitation of Western academic institutions and the national security interests at stake. Research into Chinese-language publications and the PRC's domestic scientific publication repositories could reveal higher numbers of PLA-affiliated researchers collaborating with overseas institutions and further substantiate the concrete risks of those engagements. However, peer-reviewed S&T publications from PRC sources (which include both Chinese- and English-language articles) remain virtually unexplored.

### *B. Research Design*

This chapter targets that gap with a three-step methodology for reviewing and assessing US-PRC collaborations. (See Appendix.) First, it identifies seven key PRC universities (“Seven Sons”) that directly support the country's defense research and industrial base and that operate as prime pathways for harvesting US research and diverting it to military applications. Second, using the search facilities of a major online publication repository (China National Knowledge Infrastructure, or CNKI), and

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9. Alex Joske, *Picking Flowers, Making Honey: The Chinese Military's Collaboration with Foreign Universities*, Report No. 10 (Canberra: Australian Strategic Policy Institute, 2018), <https://www.aspi.org.au/report/picking-flowers-making-honey>.

10. Alex Joske, *The China Defence Universities Tracker*, Report No. 23 (Canberra: Australian Strategic Policy Institute, 2019), <https://www.aspi.org.au/report/china-defence-universities-tracker>.

supplementary data from Elsevier's ScienceDirect, it collects a corpus of English- and Chinese-language articles published in the S&T literature with coauthors from at least one of those universities *and* a US institution. The searches ranged from January 1, 2013 to March 31, 2019 in order to spotlight recent activity. Third, it unpacks illustrative cases from that corpus to expose their concrete links to PRC military programs. In order to keep the discussion focused on problematic practices and institutional relationships rather than on individuals and ethnicity, we choose not to identify specific coauthors by name. Given the PRC's global reach and access to scientific collaboration, publication records listing authors affiliated with institutions in other nations should also be analyzed for similar national security and research integrity concerns.

### *C. Research Limitations*

Our research design has several limitations:<sup>11</sup>

- The survey of publications was limited to scientific journals and theses/dissertations. Conference proceedings, patents, and other types of information on scientific research exceed the scope of this chapter.
- CNKI offers a comprehensive repository of scientific publications, but it is not exhaustive. The collected corpus may not capture every publication in the scientific literature with authors from US institutions and Seven Sons universities.
- No technical assessments were made on the research in the collected corpus to determine potential military applications, assessments of PRC military capabilities, or comparisons to US military systems.
- An unscientific sample was selected from the collected corpus for scrutiny. Many other articles in the corpus merit close investigation.
- CNKI's web interface has reliability issues. Specifically, the CNKI website returned different results for the same searches performed

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11. A detailed explanation of these limitations is provided in the Appendix to this chapter.



at different times. Performing identical searches repeatedly using different internet points of presence and collating the results mitigated this limitation.

- CNKI is operated by state-owned companies under the oversight of the Chinese Communist Party (CCP) and engages in documented censorship of search results.<sup>12</sup>

To be absolutely clear, we allege no specific transgressions, criminal or ethical, and acknowledge that the evidence presented here is circumstantial. In certain instances, the research underlying the cases featured in this chapter may have all been conducted in the PRC and later published at a moment when one or more of the coauthors had an affiliation with a US institution, which would admittedly render the US connection tenuous. It is also possible that some of the PRC-based coauthors who cite US affiliations or US government support for their research may have misrepresented or inflated those claims, but because we lack the investigatory authority to independently determine the relevant facts, we take them at their word.

We grant that the research featured in this chapter may be fundamental in nature and have no immediate, discernible military value, and that if it has civilian applications then it is legitimately subject to commercialization and fair competition in the marketplace. Furthermore, we welcome the PRC's growing role in global scientific and technological research and recognize that some of the information flows arising out of international collaborations with it may benefit all of the parties to them, and indeed humanity more generally.

#### *D. Purpose of This Chapter*

Our aim is not to audit these collaborations or to impugn the motivations or integrity of any particular participant, but rather to empirically document the alarming and inadequately screened institutional relationships

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12. China's ability to censor academic journals was explored in Glenn D. Tiffert, "Peering Down the Memory Hole: Censorship, Digitization, and the Fragility of Our Knowledge Base," *American Historical Review* 124, no. 2 (April 2019): 550–68.

that lurk behind many of them, and the national and economic security interests at stake. Although our search criteria were narrow, they generated a rich body of evidence that reflects poorly on the state of research governance in the United States and portends ominously for the application of our methodology to other domains. The Seven Sons defense research universities share a clear mission to support the PRC's military-civil fusion efforts and defense industrial base, and the cases featured in this chapter substantiate specific, unambiguous links to the PRC's defense programs or classified weapons research. On these facts alone, pursuing S&T research collaborations with Seven Sons universities is unwise and contrary to US national interests.

## **II. Overview of the PRC's Seven Sons of National Defense (Universities)**

The seven universities profiled in this chapter have a long history of supporting the PRC's military programs. From the early 1980s until 2008, they were directly managed by the Commission for Science, Technology and Industry for National Defense (COSTIND; 国防科学技术工业委员会). COSTIND was a PRC State Council (central government) organ responsible for formulating policies and regulations for defense industries. It oversaw the structure and subsequent reorganization of defense enterprises and institutes; drafted annual plans for R&D, production, investment, and "foreign fund utilization" of defense industries; coordinated military procurement; formulated industrial policies and development plans for nuclear, aerospace, aviation, shipbuilding, ordnance, and military electronics industries; and organized "international exchange and cooperation concerning defense industries."<sup>13</sup>

In 2008, the PRC restructured a number of State Council organs and created the Ministry of Industry and Information Technology (MIIT),

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13. "2002 年中国的国防"白皮书 [2002 Chinese National Defense White Paper], 中华人民共和国国防部 [Ministry of National Defense of the People's Republic of China], January 6, 2011, [http://www.mod.gov.cn/affair/2011-01/06/content\\_4249946\\_4.htm](http://www.mod.gov.cn/affair/2011-01/06/content_4249946_4.htm).

which absorbed COSTIND. Since then, MIIT has directly administered the seven defense research universities, often referred to as the “Seven Sons of National Defense” (国防七子) or sometimes the “Seven Schools of National Defense” (国防七校).<sup>14</sup> MIIT’s website itself uses this “Seven Sons of National Defense” term, which includes the following institutions:<sup>15</sup>

1. Beijing Institute of Technology (北京理工大学)
2. Beihang University (aka Beijing University of Aeronautics and Astronautics, 北京航空航天大学)
3. Harbin Institute of Technology (哈尔滨工业大学)
4. Harbin Engineering University (哈尔滨工程大学)
5. Northwestern Polytechnical University (西北工业大学)
6. Nanjing University of Aeronautics and Astronautics (南京航空航天大学)
7. Nanjing University of Science and Technology (南京理工大学)

The core missions of these universities include supporting the PRC’s military and defense industrial base and its state-directed military-civil fusion efforts. Hence, even if some of the scientific and engineering research that they conduct is in civilian sectors, or is basic or fundamental in nature, it is safe to assume that they will consider military applications as a matter of policy. Consequently, international research collaboration via formal agreements or informal arrangements (known or unknown), student exchanges, or any other form of research facility or resource sharing between US institutions and the Seven Sons universities

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14. “国防七校 [Seven Schools of National Defense],” 百度百科 [Baidu Baike], accessed June 13, 2020, <https://baike.baidu.com/item/%E5%9B%BD%E9%98%B2%E4%B8%83%E6%A0%A1>.

15. 吴志华 [Wu Zhihua], “国防七子”招生就业办领导首秀江西国科 [“National Defense Seven Sons” Admissions and Job Placement Office Leaders Visit Jiangxi National Defense Technology Military Industry Group for the First Time],” 国家军民融合公共服务平台 [National Military-Civil Fusion Public Service Platform], June 21, 2017, <http://jmjh.miit.gov.cn/web/newsInfoWebMessage.action?newsId=493942&moduleId=1062>.

**Table 1: Number of Articles Published in S&T Journals (January 2013–March 2019) with Seven Sons and US Institutional Coauthorship**

PRC University	Articles with US Coauthorship	US Institutions Represented
Harbin Institute of Technology	106	63
Nanjing University of Science and Technology	36	32
Northwestern Polytechnical University	32	28
Beijing Institute of Technology	31	27
Beihang University	28	22
Harbin Engineering University	15	16
Nanjing University of Aeronautics and Astronautics	6	5

demands careful scrutiny. Table 1 summarizes the results yielded by our research methodology.

**III. Harbin Institute of Technology: Collaboration with US Research Institutions**

*A. Summary of Findings*

The Harbin Institute of Technology (哈尔滨工业大学, HIT) is a large university that describes itself as “serving national defense” and focuses on aerospace in particular.<sup>16</sup> In the 1960s and 1970s, HIT refocused its mission to “primarily serve national defense construction and military-civil integration.” HIT’s ties to the PRC’s defense research and industrial base include the following:

- A partnership with PRC state-owned defense conglomerate China Aerospace Science and Technology Corporation (CASC). The partnership is known as the Collaborative Innovation Center of Astronautical Science and Technology. It was modeled in part on NASA’s Jet Propulsion Laboratory and its members also include

16. “学校简介 [School Overview],” 哈尔滨工业大学 [Harbin Institute of Technology], May 7, 2020, Internet Archive, archived May 14, 2020, accessed June 15, 2020, <https://web.archive.org/web/20200514004011/http://www.hit.edu.cn/236/list.htm>.

Beihang University (another Seven Sons university), Peking University, and the University of Science and Technology of China.

- Relationships between HIT's School of Astronautics and research institutes of CASC and another state-owned defense firm, China Aerospace Science and Industry Corporation (CASIC), as well as "close collaboration" with the PLA General Armament Department (now known as the Equipment Development Department of the Central Military Commission) and the PLA Rocket Force (previously known as the Second Artillery Force, which manages the PRC's strategic / nuclear missile arsenal).
- Two engineering research centers supporting "national defense science and technology industry."

Research topics in the collected corpus of articles appear to involve a mix of plausibly benign disciplines such as zero energy buildings and environmental and life sciences and dual-use areas such as transportation automation, lithium ion battery development, photovoltaics, materials science, and chemistry. Although the majority of articles identified were in English and some of the published research appear innocuous, supplemental information compiled on select authors and institutional affiliations, primarily from Chinese-language sources, demonstrate that some of the PRC-based entities directly support the PLA, defense industrial organizations, and defense research programs, including what appear to be classified weapons projects. It is not known whether the US partner institutions were a) aware that this research collaboration was taking place; and/or b) had knowledge of the HIT researchers' involvement in PRC defense programs. Examples of this research include the following:

- An article coauthored by HIT and Lawrence Berkeley National Laboratory-affiliated researchers included an HIT faculty member who is involved in PLA General Armament Department research programs and a member of its Stealth Technology Experts Group, as well as two State Administration of Science and Technology Industry for National Defense (SASTIND) projects.

- An article naming Columbia University, University of Texas at San Antonio and HIT-affiliated coauthors included researchers working on projects for the PRC's Central Military Commission S&T Committee, PLA General Staff Headquarters, PLA General Armament Department, and PLA Unit 65927. Some of these projects used "XXXXXX" in their title and/or funding codes that may indicate a PRC classified weapons program.
- One article involved Arizona State University collaboration with HIT, Beihang University, and a research institute under state-owned defense conglomerate Aviation Industry Corporation of China (AVIC), which supplies manufacturing technologies for national defense industries such as aerospace, electronics, weaponry, and naval vessels.
- An article coauthored by University of Michigan and HIT researchers on naval engineering included an individual who worked at naval defense conglomerate China Shipbuilding Industry Corporation. At HIT, that researcher has overseen defense projects on topics relating to ship vibration analysis, transmission, or prediction techniques—two of which may have been classified projects given the use of "XXX" in the research grant codes.

A secondary search of CNKI identified seven Chinese-language publications involving HIT that credit the US National Science Foundation (NSF) and the NIH, raising concerns that the PRC may be using US taxpayer-funded research to further the PRC's military modernization efforts. Six of these records are master's theses and doctoral dissertations. Four of the dissertations credit the PRC government-run China Scholarship Council (CSC) for funding their authors' study abroad at US institutions. This suggests that these students used US government-funded research conducted in the United States in partial fulfillment of their advanced degrees at HIT.

### *B. Overview of HIT and Support to the PRC's National Defense*

HIT was founded in 1920 and came under CCP administration in 1950. It is a large university, with three campuses (Harbin, Shenzhen, and

Weihai) totaling more than 43,500 students (of which there are 16,384 graduate students) and more than 6,800 faculty and staff.<sup>17</sup> HIT is involved in a number of scientific and social science disciplines that may not involve defense research, such as architecture, environmental and life sciences, economics, law, humanities, etc., and it has one of the top-ranked engineering programs in the world.<sup>18</sup>

However, at its core, HIT is involved in national defense fields.<sup>19</sup> In the 1960s and 1970s, HIT changed its focus from a “multi-disciplinary technical university” to an institution that “primarily serves national defense construction and military-civil integration” in order to “strengthen the needs of national defense modernization.”<sup>20</sup> In particular, HIT claims to have established the PRC’s first aerospace academy. Its key contributions to aerospace and defense-related developments include the following:

- Testing of the PRC’s first satellite-to-earth high-speed laser communication.
- The first “completely automated laser-target coupling process,” used by the Shengguang 3 at the PRC’s Laser Fusion Research Center (which conducts inertial confinement fusion research that may have nuclear weapons applications).
- Seven independently developed satellites in the PRC, including the first microsatellite developed and controlled by students.

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17. “Harbin Institute of Technology 2017 Brief Introduction,” Harbin Institute of Technology Office of Global Affairs, 2017, Internet Archive, archived November 15, 2019, accessed June 15, 2020, <https://web.archive.org/web/20191115123613/http://en.hit.edu.cn/pdf/2017HIT%20Brief%20Introduction.pdf>.

18. “Best Global Universities for Engineering,” *U.S. News & World Report*, accessed June 13, 2020, <https://www.usnews.com/education/best-global-universities/engineering>.

19. “学校简介 [School Overview],” 哈尔滨工业大学 [Harbin Institute of Technology], 2020.

20. “哈工大精神 [The Spirit of HIT],” 哈尔滨工业大学 [Harbin Institute of Technology], May 16, 2017, Internet Archive, archived May 12, 2020, accessed June 15, 2020, <https://web.archive.org/web/20200512095003/https://hit.edu.cn/240/list.htm>.

- The first “new system radar.”
- The world’s first experimental use of a magnetic field Hall thruster for space.
- The world’s first microsatellite that conducted a circumlunar flight.
- “Major contributions” to the successful inaugural launches of the Long March 5 and Long March 7 carrier rockets (manufactured by the China Academy of Launch Vehicle Technology (CALT), a unit of the China Aerospace Science and Technology Corporation).<sup>21</sup>

In 2008, HIT founded the Joint Technology Innovation Center in conjunction with CASC. This center became part of the Aerospace Science and Technology Innovation Institute founded two years later and became part of the Collaborative Innovation Center of Astronautical Science and Technology founded in 2012.<sup>22</sup>

An English-language brochure for a 2018 HIT PhD program claimed that HIT’s School of Astronautics had established a “close relationship with research institutes in both CASC and CASIC,” another major state-owned defense conglomerate. The brochure added that “our school’s close collaboration with the PLA General Armament Department and the Second Artillery Force has greatly contributed to the construction of national defense.”<sup>23</sup> The PLA’s Second Artillery Force (now known as the PLA Rocket Force) is the PRC’s strategic missile force, which includes its nuclear weapons arsenal.

HIT also has two engineering research centers directly tied to the PRC’s defense industrial base, known in English as the Ultra-Precision Machining Research and Application Center for National Defense Science and Technology Industry, and the Welding Automation Research

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21. “学校简介 [School Overview],” 哈尔滨工业大学 [Harbin Institute of Technology], 2020.

22. “Harbin Institute of Technology 2017 Brief Introduction,” 2017.

23. “Harbin Institute of Technology-APSCO Full English PhD Program 2018,” Harbin Institute of Technology, accessed June 13, 2020, [https://uzay.tubitak.gov.tr/sites/images/uzay/1\\_hit-phd\\_program-2018\\_announcement\\_.pdf](https://uzay.tubitak.gov.tr/sites/images/uzay/1_hit-phd_program-2018_announcement_.pdf).



and Application Center for National Defense Science and Technology Industry.<sup>24</sup> HIT has a number of other research centers (twenty are listed only in Chinese on HIT's website), many of which may support HIT's defense R&D or industrial base. Below are names of some of these centers and approximate English translations, but this is not an exhaustive list of HIT subdivisions that may conduct defense research.<sup>25</sup>

- Research Institute for Gas Dynamics of Engine (发动机气体动力研究中心)
- Control and Simulation Center (控制与仿真中心)
- Analysis and Testing Center (分析测试中心)
- Ceramic Engineering Technology Center (陶瓷工程技术中心)
- Space Debris Hypervelocity Impact Research Center (空间碎片高速撞击研究中心)
- Microelectronics Research Center (微电子研究中心)
- Center for Precision Engineering (精密工程研究中心)
- Electroplating Research Center (电镀研究中心)
- Freespace Optical Communication Technology Research Center (空间光通信技术研究中心)
- Space Control and Inertial Technology Research Center (空间控制与惯性技术研究中心)
- Hydrodynamic Forming Engineering Research Center (液力成形工程研究中心)
- Special Processing Research Center (特种加工研究中心)
- Condensed Matter Physics Science and Technology Research Center (凝聚态科学与技术研究中心)<sup>26</sup>

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24. Harbin Institute of Technology, "Harbin Institute of Technology 2017 Brief Introduction," 2017, available at: [https://educationdocbox.com/Graduate\\_School/73727462-Harbin-institute-of-technology.html](https://educationdocbox.com/Graduate_School/73727462-Harbin-institute-of-technology.html).

25. If HIT supplies an English name, then the authors have used it.

26. "研究所/中心 [Research Institutes and Research Centers]," 哈尔滨工业大学 [Harbin Institute of Technology], June 3, 2018, Internet Archive, archived May 12, 2020, accessed June 15, 2020, <https://web.archive.org/web/20200512085553/https://hit.edu.cn/256/list.htm>.

HIT aggressively recruits experts from around the world through the PRC's national state-sponsored talent programs. These recruits include 47 specially invited professors (selectees) of the Changjiang Scholars Award Program<sup>27</sup> (a national program to recruit experts from overseas run by the Ministry of Education) and 31 national level “Hundred, Thousand, Ten-Thousand Talents Project” selectees. The university's English-language website omits the latter figure.<sup>28</sup> It also notes that there are 86 “long-term contract overseas experts” and 124 “part-time overseas PhD Supervisors.”<sup>29</sup> These last two statistics suggest there are 210 faculty members that retain positions overseas and simultaneously teach and conduct research at HIT, likely fostering some of the research collaboration with foreign institutions and HIT.

HIT also claims that it has signed academic cooperation agreements with 316 institutions of higher education in 35 countries. In 2016, 2,305 HIT students were sent to study overseas and HIT received 2,773 international students from 128 countries and regions.<sup>30</sup> In June 2020, HIT was added to the US Department of Commerce's Entity List for export control purposes, but this may not limit collaboration with US institutions if the research is categorized as fundamental in nature.<sup>31</sup>

### *C. Survey of Scientific Publications*

Bibliographic data was compiled from CNKI using HIT and United States (美国) as search terms in the author affiliations fields. HIT's large size and the diversity of its programs means that some research disciplines may not have any obvious military applications. About half of the 106

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27. HIT's English-language website, which is probably not updated as often, states that there are 43 Changjiang Scholars.

28. “学校简介 [School Overview],” 哈尔滨工业大学 [Harbin Institute of Technology], 2020.

29. Harbin Institute of Technology, “2017 Brief Introduction.”

30. Harbin Institute of Technology, “2017 Brief Introduction.”

31. Bureau of Industry and Security, Commerce, “Addition of Entities to the Entity List, Revision of Entries on the Entity List,” *Federal Register* 85, no. 109 (June 5, 2020): 34495, <https://www.govinfo.gov/content/pkg/FR-2020-06-05/pdf/2020-10869.pdf>.

identified articles in the collected corpus are in fields such as architecture, environmental and civil engineering, new energy technologies, life sciences, and transportation, although some of this research may have dual-use potential. The remainder of the articles are in engineering, computer science, materials science, aeronautical, and aerospace fields that are more closely allied with the PRC's defense industrial and research base. Four examples are profiled below.

Given that the US government views the PRC as a strategic competitor and military rival, collaborations between US government-funded research facilities and programs (e.g. Department of Energy national laboratories) and HIT are presumptively problematic, irrespective of whether the research is intended for beneficial civilian use. It is simply inappropriate for US government facilities to support collaboration with a key PRC defense research institution, especially in the absence of robust vetting.

Within the corpus of 106 articles, thirteen had US government-affiliated coauthors. These articles cover a mix of seemingly innocuous research areas such as zero energy buildings and environmental and life sciences, and potential dual-use areas such as transportation automation, lithium ion battery development, photovoltaics, materials science, and chemistry. Just the same, supplemental research reveals that some of the PRC-based coauthors have directly supported PLA and defense programs, including what appears to be classified weapons projects.

### ***Example 1: Lawrence Berkeley National Laboratory***

#### ***Collaboration with HIT***

A superficial examination of an English-language article that names authors affiliated with HIT and the Department of Energy's (DoE) Lawrence Berkeley National Laboratory's (LBNL) Plasma Applications Group and Molecular Foundry may not identify national security concerns.<sup>32</sup> The article published in 2013 entitled "Transparent and conductive indium doped cadmium oxide thin films prepared by pulsed filtered cathodic arc deposition," credits DoE funding via the "LDRD Program

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32. Also found in Elsevier's ScienceDirect.

of LBNL, in-part by the Assistant Secretary for Energy Efficiency and Renewable Energy under Contract No. DE-AC02-05CH11231” and a “user project at the LBNL Molecular Foundry supported by the Office of Science, Office of Basic Energy Sciences.”<sup>33</sup> However, examination of the HIT-affiliated authors reveal direct ties to PRC defense programs.

No further information was found on one of the authors who claims dual LBNL and HIT affiliation. It is possible that this author was a visiting PhD student while conducting studies at HIT based on the fact that a) the article credits the “PhD Programs Foundation” of the PRC’s Ministry of Education for funding support, and b) other coauthors appear to hold faculty positions.<sup>34</sup>

This publication’s most concerning aspect relates to a second HIT-affiliated coauthor. A PRC website posted what appears to be this author’s complete curriculum vitae (CV), indicating that he is a professor and doctoral advisor at HIT’s School of Astronautics, where he conducts research on photonics and thin film-related materials science. He has worked with the (formerly named) PLA General Armament Department on multiple projects. Specifically, the CV lists “major positions” and research projects that should presumptively disqualify him from participation in US government-funded research:

- Served as a PLA General Armament Department Stealth Technology Experts Group Member
- Served as a PLA General Armament Department Military Use Electronic Components Technology Expert Evaluator
- Oversaw five PLA General Armament Department Preliminary Research Fund projects (总装预研基金 5 项) and two Preliminary Research Plan projects (总装预研计划 2 项)

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33. Yuankun Zhu, Rueben J. Mendelsberg, Jiaqi Zhu, Jiecai Han, and André Anders, “Transparent and Conductive Indium Doped Cadmium Oxide Thin Films Prepared by Pulsed Filtered Cathodic Arc Deposition,” *Applied Surface Science* 265 (January 2013): 738–44, <https://doi.org/10.1016/j.apsusc.2012.11.096>.

34. This is consistent with other articles surveyed in this study, in which individuals claiming dual US- and China-based affiliations were temporarily based in the United States as graduate students or postdoctoral researchers.

- Oversaw two SASTIND military products projects, multiple aerospace and aviation projects, and “[unnamed] Major National Science, Technology, and Engineering Fundamental Research Projects” (the lack of specificity on the latter may refer to classified research programs)<sup>35</sup>

A third HIT-affiliated researcher named in this article has coauthored many publications and filed patents with the second HIT author and may well be carrying out similar research supporting the PRC’s military programs.

***Example 2: Columbia University, University of Texas at San Antonio Collaboration with HIT and Harbin Engineering University***

The second article, entitled “Weakly supervised codebook learning by iterative label propagation with graph quantization,” was published in 2013 in the English-language journal *Signal Processing*. The article lists authors affiliated with HIT, Harbin Engineering University, Columbia University, and the University of Texas at San Antonio.<sup>36</sup>

The three PRC-affiliated coauthors appear to have professional connections to each other, and two have participated in numerous PRC defense research programs. At the time of the article’s publication, the author affiliated with Harbin Engineering University (another Seven Sons university) was completing a PhD degree. This coauthor is now an associate professor at Xiamen University’s Computer Science department and conducts research on spatial data science, remote sensing image interpretation, cloud data management, and multimedia content retrieval.<sup>37</sup>

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35. “哈尔滨工业大学研究生导师简介-朱嘉琦 [Harbin Institute of Technology Graduate Student Supervisors-Zhu Jiaqi],” FREE 研究生招生 [FREE Graduate Student Recruitment], April 1, 2016, <http://school.freekaoyan.com/heilongjiang/hit/daoshi/2016/04-01/1459455102545914.shtml>.

36. Liujuan Cao, Rongrong Ji, Wei Liu, Hongxun Yao, and Qi Tian, “Weakly Supervised Codebook Learning by Iterative Label Propagation with Graph Quantization,” *Signal Processing* 93, (August 2013): 2274–83, <https://doi.org/10.1016/j.sigpro.2012.05.001>.

37. “曹刘娟 副教授 [Associate Professor Cao Liujuan],” School of Informatics, Xiamen University, accessed June 13, 2020, <https://information.xmu.edu.cn/info/1019/3182.htm>.

The other PRC-based coauthors have more direct ties to defense programs. One of the authors claimed both a Columbia University and HIT affiliation for this article. According to biographical information posted on his current employer's website (Xiamen University), he received a PhD in 2011 from HIT, where he worked with his advisor (the third PRC-based coauthor of this article). From late 2010 through 2013, the former held a postdoctoral researcher position at Columbia University.<sup>38</sup> He is currently employed at Xiamen University's School of Information Science and Technology and is a 2017 "youth" selectee of the PRC government-run Ten-Thousand Talents Program.<sup>39</sup> Notably, he has worked on several defense projects, including the following:

- A "Central Military Commission S&T Committee High Technology Special Project."
- Preliminary research under the 13th Five-Year Plan for the PLA General Staff Headquarters
- Preliminary research under the 12th Five-Year Plan for the PLA General Armament Department
- Technology development projects in partnership with Tencent, Huawei, and DiDi<sup>40</sup>

Although it is not known if the research on behalf of Huawei, Tencent, and DiDi overlapped or was integrated with the defense special projects this coauthor conducted, its striking appearance among them underscores how research collaborations with US institutions may contribute to the development of dual-use technologies in the PRC and benefit PRC firms at the expense of US economic competitiveness.

Lastly, the third PRC-based coauthor is a professor at HIT's School of Computer Sciences Center for Intelligent and Human Machine Interface. This professor's CV lists work on multiple defense research projects,

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38. "纪荣嵘 [Ji Rongrong]," Media Analytics and Computing Lab, Xiamen University, 2020, accessed June 13, 2020, <http://mac.xmu.edu.cn/rjji-cn.html>.

39. "纪荣嵘 [Ji Rongrong]."

40. "纪荣嵘 [Ji Rongrong]."

including those listed below. The use of “X” in project names or funding codes likely refers to classified programs.

- PLA General Armament Department “Panoramic View XXXXXX System Preliminary Research Project” (Mar. 2011-Dec. 2015)
- PLA Unit 65927 “Border Crossing Automated Warning System” project (Jan. 2007-Dec. 2009)
- MIIT “242 Project” (no title provided) with funding code “XXXXXX (2005C41)”<sup>41</sup>

Given that both HIT-affiliated coauthors are actively involved in defense research programs, some of which are directly under the PLA, it would be prudent to assume that the research published in collaboration with US universities will also flow directly to the PRC military. Because the background information about these coauthors was derived exclusively from Chinese-language sources, it is not known if the US universities were aware of their associations with the PLA. Assuming that the collaboration complied with US export controls, this case demonstrates the inadequacy of that standard as a test for assessing risk.

***Example 3: Arizona State University Collaboration with HIT, PRC Aerospace Defense Conglomerate***

An English-language article published in 2017 entitled “Effect of gallium addition on the microstructure and micromechanical properties of constituents in Nb-Si based alloys” had eight contributing authors, some of whom are affiliated with HIT, Beihang University, and AVIC.<sup>42</sup> Supplemental research on the PRC-based authors and institutions demonstrates clear ties to the PRC’s defense research and industrial base.

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41. “姚鸿勋 [Yao Hongxun],” Harbin Institute of Technology, accessed June 13, 2020, <http://homepage.hit.edu.cn/yaohongxun>.

42. Enyu Guo et al., “Effect of Gallium Addition on the Microstructure and Micromechanical Properties of Constituents in Nb-Si Based Alloys,” *Journal of Alloys and Compounds* 704, (May 2017): 89–100, <https://doi.org/10.1016/j.jallcom.2017.02.054>.

The article lists eight authors affiliated with one or more of the following institutions:

1. Materials Science and Engineering, Arizona State University (ASU)
2. School of Materials Science and Engineering, Harbin Institute of Technology
3. International Research Institute for Multidisciplinary Science, Beihang University
4. AVIC Beijing Aeronautical Manufacturing Technology Research Institute (BAMTRI)
5. Department of Materials Science and Engineering, Indian Institute of Technology, Kanpur, Uttar Pradesh

One of the two HIT-affiliated authors has been an associate researcher at HIT's School of Materials Science and Engineering since late 2013 and specializes in titanium and aluminum alloys. That author has worked with or at HIT's National Key Laboratory for Precision Hot Processing of Metals and, according to his faculty page, has worked on "national defense preliminary projects."<sup>43</sup>

Supplemental searches on CNKI's web interface indicate that the AVIC-affiliated researcher has coauthored a number of articles with the aforementioned HIT scientist and conducted similar research at BAMTRI. BAMTRI is the headquarters component of the Aviation Industry Corporation of China (AVIC) Manufacturing Technology Institute (MTI).<sup>44</sup>

MTI's English-language page states that this AVIC subsidiary focuses on "fundamental, application [*sic*], engineering, industrialization R&D of aeronautical materials, manufacturing technologies and special equipment" for new aircraft and aero-engines and provides support to "aerospace, electronics, ship, defense, and other industries." MTI houses key laboratories that involve "additive manufacturing, welding and joining,

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43. "骆良顺 [Luo Liangshun]," Harbin Institute of Technology, accessed June 13, 2020, <http://homepage.hit.edu.cn/luols>.

44. BAMTRI is on the Department of Commerce's Entity List.



digital manufacturing, metal forming, precise manufacturing, and high performance electro-magnetic windows.”<sup>45</sup>

MTI’s Chinese-language page describes itself as a “comprehensive research organ specializing in aviation and national defense advanced manufacturing technologies and special use equipment development.” BAMTRI is also known as the AVIC 625 Institute (625所) and develops “transformational research for the PRC’s new and emerging airplanes, engines, cruise missiles, and related aviation equipment.” BAMTRI supplies “advanced manufacturing technologies for national defense industries such as aerospace, electronics, weaponry, ships, etc.” Lastly, the organization claims to have “long-standing technology exchanges and economic cooperative relations with 30+ countries,” including the US, Russia, Germany, France, Italy, and Japan.<sup>46</sup>

***Example 4: University of Michigan Collaboration with HIT on Naval Engineering***

The last article examined—also an English-language publication available on Elsevier’s website—was published in January of 2019 and named coauthors from HIT’s College of Naval Architecture and Ocean Engineering (Weihai campus) and the University of Michigan’s Department of Naval Architecture and Marine Engineering. Entitled “Numerical and experimental analysis of hydroelastic responses of a high-speed trimaran in oblique irregular waves,”<sup>47</sup> some of its authors have backgrounds in defense research projects.

One of the authors claimed a dual affiliation with the University of Michigan and HIT. The version of that author’s CV that appears on

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45. “MTI Profile,” AVIC Manufacturing Technology Institute, accessed June 13, 2020, <http://www.avicmti.avic.com/enweb/aboutus/mtip/index.shtml>.

46. “制造院简介 [Introduction to the Manufacturing Technology Institute],” AVIC Manufacturing Technology Institute, accessed June 13, 2020, <http://www.avicmti.avic.com/gxwm/zcyjg/index.shtml>.

47. Zhanyang Chen, Hongbin Gui, Pingsha Dong, and Changli Yu, “Numerical and Experimental Analysis of Hydroelastic Responses of a High-Speed Trimaran in Oblique Irregular Waves,” *International Journal of Naval Architecture and Ocean Engineering* 11 (January 2019): 409–21, <https://doi.org/10.1016/j.ijnaoe.2018.07.006>.

HIT's website, however, makes no mention of the University of Michigan affiliation. The CV states the author began his studies at HIT in 2004 and received BS and PhD degrees (completed December 2013) from the College of Naval Architecture and Ocean Engineering. Beginning April of 2014, he was employed by the same department at HIT.<sup>48</sup> This author has partnered with another of the article's HIT-affiliated coauthors on at least one other publication that involved naval research, which also included a Harbin Engineering University-affiliated professor.<sup>49</sup>

The other PRC-based author serves as vice dean of HIT's College of Naval Architecture and Ocean Engineering.<sup>50</sup> Interestingly, this author's faculty profile on HIT's website is not viewable from US-based internet points of presence. However, Chinese Baike—a PRC analog to Wikipedia hosted by search engine and internet firm Baidu—provides biographical information on the author and some of his research projects. According to this source, he served as a senior engineer at a major state-owned defense firm (China Shipbuilding Industry Corporation's 702nd Research Institute) from 2003 to 2008. He subsequently worked at HIT as a professor, department head, and since July 2014, as vice dean of its College of Naval Architecture and Ocean Engineering. He has overseen defense research projects on topics relating to ship vibration analysis, transmission, or prediction techniques.<sup>51</sup> A sampling of these research projects include the following:

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48. “陈占阳 [Chen Zhanyang],” Department of Postgraduate, Harbin Institute of Technology at Weihai, accessed June 13, 2020, <http://yjsc.hitwh.edu.cn/2017/0517/c1096a41314/page.htm>.
  49. 陈占阳 [Chen Zhanyang] et al., “舰船非线性设计值的水弹性直接计算方法 [Direct Calculation Method for Nonlinear Design Loads of Warship Based on Hydroelasticity Theory],” 哈尔滨工程大学学报 [*Journal of Harbin Engineering University*], 38, (January 2019): 37–42, <https://doi.org/10.11990/jheu.201507066>.
  50. “海洋工程学院 [Marine Engineering School],” Harbin Institute of Technology at Weihai School of Marine Engineering, accessed June 13, 2020, <http://snaoe.hitwh.edu.cn/41/list.htm>.
  51. “桂洪斌 [Gui Hongbin],” 百度百科 [Baidu Baike], accessed June 14, 2020, [https://baike.baidu.com/item/%E6%A1%82%E6%B4%AA%E6%96%8C#reference-\[1\]-4416584-wrap](https://baike.baidu.com/item/%E6%A1%82%E6%B4%AA%E6%96%8C#reference-[1]-4416584-wrap).

- 863 Program (a national level R&D program that supports defense research) project on optimal design of subsurface systems and marine instrumentation
- Two research grants listed only as “XXX” (probably referring to classified research) associated with the PLA Navy Equipment Department
- China Shipbuilding Industry Corporation-sponsored project on “submarine vibration and acoustic radiation prediction techniques.”<sup>52</sup>

#### *D. Secondary Search: US Research Funding*

A second set of searches of CNKI bibliographic records examined articles that named a US institution as providing funding support and at least one author affiliated with HIT. Seven Chinese-language publications were identified, including six theses and dissertations published at HIT and one article that appeared in a scientific journal shown in Table 2. The English translations of the titles were provided by the authors of the publications. Five of the records claim US NSF support; one claims involvement in a “China-US International Cooperation Project,” and one claims US NIH funding. Unfortunately, it matters little if the authors reported their HIT affiliations to these funding institutions, because the institutions typically lack the mandate and toolset to properly assess the significance of those disclosures.

#### *E. Observations on Identified Theses and Dissertations*

Four of these titles, three of which are PhD dissertations, credit CSC funding for supporting their authors’ study abroad. The NSF and NIH funding sources identified in the dissertations indicate that the authors used US government-funded research conducted in the United States towards partial fulfillment of their PhD degree requirements from HIT. Quite possibly, these students were working under recipients of NSF and NIH funding (i.e., principal investigators) and were compensated by the

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52. “桂洪斌 [Gui Hongbin].”

Table 2: Research Naming US Funding Support and HIT Author Affiliation

Title	Organizations	Source	Funding*
数控无心磨床能量特性与等效碳排放量的建模与分 析 (Modeling and Analysis of Energy Characteris- tics and Equivalent Carbon Emissions of CNC Centerless Grinding Machine)	HIT	HIT (June 2018 master's thesis)	China National Natural Science Foundation; China-US International Cooperation Project
基于角度坐标描述的三维柔性大变形梁动力学建模 方法研究 (Research on Three-Dimensional Flexible-Large Deformation Beam Formulations Based on Rotational Coordinate [sic] Descriptions)	HIT	HIT (July 2017 PhD dissertation)	China National Natural Science Foundation; US NSF
双乳液滴内核可控包裹与融合机制及实验研究 (Mechanism and Experimental Research on Controllable Encapsulation and Coalescence of Inner Droplets in Double-Emulsion Drops)	HIT	HIT (June 2017 PhD dissertation)	CSC; China National Natural Science Foundation; US NSF
细菌运动中的物理生物学 (Physical Biology of Bacterial Motility)	HIT; China University of Science and Technology; Chinese University of Hong Kong and Chinese University of Hong Kong Shenzhen Research Institute; Brown University	(2016) Journal of Physics (aka Acta Physica Sinica) (物理学报)	US NSF (award CBET 1438033); Chinese Academy Sciences Institute of Theoretical Physics State Key Laboratory of Theoretical Physics Fund (Y4KF161CJ1); CSC; China National Natural Science Foundation (11374282, 21573214, 21473152); Research Grants Council of Hong Kong Special Administrative Region (CUHK409713)
集成微流控芯片及单细胞基因表达检测研究 (Integrated Microfluidic Chips for Single-Cell Gene Expression Profiling)	HIT	HIT (Septem- ber 2015 PhD dissertation)	CSC; US NIH
基于交流电场的生物分子快速检测及其实验研究 (AC Electric Field Based Rapid Detection of Biomolecules and Experimental Studies)	HIT	HIT (2014 PhD dissertation)	CSC; China National Natural Science Foundation; US NSF; Zhejiang University State Key Laboratory of Fluid Power Transmission and Control Development Fund
聚苯胺及其纳米复合材料巨磁阻性能研究 (Giant Magnetoresistance in Polyaniline and Its Nanocomposites)	HIT	HIT (December 2013 PhD dissertation)	China National Natural Science Foundation; US NSF

\* The authors of this study provided translations of the PRC funding grants when no English was provided.

PRC government to do so via the CSC. Details on four of the five dissertations follow; no additional information on the fifth was found.

- The July 2017 dissertation was submitted to HIT's School of Astronautics. Its author studied at the University of Maryland Baltimore Campus from December 2014 to December 2016.<sup>53</sup>
- The June 2017 dissertation was submitted to HIT's School of Mechatronics [*sic*] Engineering.<sup>54</sup> Its author was affiliated with HIT's Robotics and Systems National Key Laboratory and studied at the University of Pennsylvania from September 2013 to September 2015.
- The September 2015 dissertation was submitted in support of HIT's Aeronautics and Astronautics Manufacturing Engineering program. The author attended Columbia University from September 2012 to September 2014 as a visiting PhD student, and specifically named three NIH grants that supported the dissertation: 5U19AI067773, 8R21GM104204, 2P41EB002033-19A1.<sup>55</sup> The first

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53. 樊伟 [Fan Wei], "[基于角度坐标描述的三维柔性大变形梁动力学建模方法研究] Research on Three-Dimensional Flexible Large-Deformation Beam Formulations Based on Rotational Coordinate Descriptions" (PhD diss., Harbin Institute of Technology, 2017), <http://new.oversea.cnki.net/KCMS/detail/detail.aspx?dbcode=CDFD&dbname=CDFDLAST2019&filename=1018897420.nh&v=Mjg0MzgVQVZGMjZGcnV4R2RYT3I1RWJQSvI4ZVgxTHV4WVM3RGgxVDNvVHJXTTFGckNVUjdxZlIlZHBGeTNRv3I=>.

54. 侯立凯 [Hou Likai], "双乳液滴内核可控包裹与融合机制及实验研究 [Mechanism and Experimental Research on Controllable Encapsulation and Coalescence of Inner Droplets in Double-Emulsion Drops]" (PhD diss., Harbin Institute of Technology, 2017), <http://new.oversea.cnki.net/KCMS/detail/detail.aspx?dbcode=CDFD&dbname=CDFDLAST2018&filename=1017862365.nh&v=Mjk1NjNVUjdxZlIlZHBGeTNRv3IvSVZGMjZHYnUrSE5MS3FwRWJQSvI4ZVgxTHV4WVM3RGgxVDNvVHJXTTFGckM=>.

55. 孙浩 [Sun Hao], "集成微流控芯片及单细胞基因表达检测研究 [Integrated Microfluidic Chips for Single-Cell Gene Expression Profiling]" (PhD diss., Harbin Institute of Technology, 2017), <http://new.oversea.cnki.net/KCMS/detail/detail.aspx?dbcode=CDFD&dbname=CDFDLAST2017&filename=1016739476.nh&v=MDUyOTFMcVpFY1BJUjhlWDFMdxhZUzdEaDFUM3FUcldNMUZyQ1VSN3FmWWVkcEZ5M2tXNjY9MVkYyNkdMUzdGOVg=>.

grant deals with developing rapid methods to identify individuals who have significant exposure to radiation, especially from an improvised nuclear device or dirty bomb.<sup>56</sup>

- The December 2013 dissertation was submitted to HIT's School of Chemical Engineering and Technology. Another 2013 article coauthored by this PhD student shows him affiliated with HIT and Lamar University (perhaps as a visiting PhD student).

Again, only a small subset of the corpus of 106 articles was examined here. Research on the affiliations and authors of the other articles may identify additional instances in which US government funding agencies are supporting researchers at universities integral to the PRC defense establishment.

## **IV. Nanjing University of Science and Technology: Collaboration with US Research Institutions**

### *A. Summary of Findings*

The Nanjing University of Science and Technology (南京理工大学, NJUST) was originally founded in 1953 as the PLA Engineering Institute. After relocating to Nanjing in 1962, NJUST has been focused on developing weapons technologies and related systems.

- NJUST has a nationally designated discipline in “weapons science and technology construction,” and has created ten “special national defense disciplines” and nine “national defense science and technology innovation teams.”
- NJUST's School of Energy and Power Engineering integrates numerous defense disciplines, including ordnance firing theory and technology, weapons systems and applications engineering, fluid dynamics, and engineering thermophysics.

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56. David J. Brenner, “Center for High-Throughput Minimally-Invasive Radiation Biodosimetry,” National Institutes of Health, accessed June 14, 2020, <http://grantome.com/grant/NIH/U19-AI067773-12>.

- Seven out of thirty-five articles that have authors affiliated with NJUST and US institutions name NJUST's School of Energy and Power Engineering. Supplemental research on an NJUST-affiliated coauthor listed in six articles reveals that he conducts ordnance firing, ballistics, and weapons systems research.
- A NJUST doctoral dissertation credits the US NSF but does not identify which US university hosted that NSF-funded research.

### *B. Overview of NJUST and Support to the PRC's National Defense*

NJUST was originally founded as the PLA Engineering Institute (中国人民解放军军事工程学院, or Institute of Military Engineering) in 1953. In 1962, the university relocated to Nanjing, and after some restructuring and name changes, became known as the Nanjing University of Science and Technology.<sup>57</sup> The Chinese-language website offers more details on NJUST's defense-related missions. For example, it states that the university has a long history of developing weapons and equipment, electronics, information technology, and chemical and materials science disciplines for national defense purposes. In 2017, NJUST was selected as a "Double First-Class discipline" university in "weapons science and technology construction."<sup>58</sup> This refers to the Double First Class University Plan that the PRC government initiated in 2015 in order to foster a group of elite PRC universities and individual university departments into world class universities and disciplines by the end of 2050.<sup>59</sup> NJUST

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57. "Overview," Nanjing University of Science and Technology, accessed June 14, 2020, <http://english.njust.edu.cn/582/list.htm>.

58. "学校简介 [School Overview]," 南京理工大学 [Nanjing University of Science and Technology], April 2020, <http://www.njust.edu.cn/3627/list.htm>.

59. 国务院 [State Council], "统筹推进世界一流大学和一流学科建设总体方案 [Overall Plan to Promote the Construction of World-Class Universities and First-Class Disciplines]" Document 64, October 24, 2015, [http://www.gov.cn/zhengce/content/2015-11/05/content\\_10269.htm](http://www.gov.cn/zhengce/content/2015-11/05/content_10269.htm).; "China sets direction for world class universities," Commonwealth of Australia, Department of Education, Skills and Employment, accessed June 14, 2020, <https://internationaleducation.gov.au/News/Latest-News/Pages/China-sets-direction-for-world-class-universities.aspx>.

has designated ten “special national defense disciplines” and nine “national defense science and technology innovation teams.” The university also has four award recipients of the “outstanding youth talent fund for national defense science and technology” (国防科技卓越青年人才基金获得者 4 人).<sup>60</sup>

NJUST’s School of Energy and Power Engineering is focused on weapons and defense research. Its predecessor was the Ballistics Research Institute (弹道研究所), established in 1981 by the then Ministry of Ordnance Industry. In 2010, the school was restructured into the current School of Energy and Power Engineering. The school integrates numerous defense disciplines such as ordnance firing theory and technology, which was designated as a national “Double First Class” discipline in 2017. Its weapons systems and firing engineering major is designated as a “national special major” (国家特色专业). The school runs two postdoctoral programs on weapons science and technology and mechanics and four doctoral degree programs in weapons science and technology, mechanics, control science and engineering, and engineering thermophysics. Master’s degree programs involving defense areas include the following: ordnance firing theory and technology, weapons systems and applications engineering, engineering thermophysics, fluid dynamics, engineering mechanics, refrigeration and cryogenic engineering, electronics systems and automation, and ordnance engineering. Lastly, the school claims to have a long history of conducting civilian- and military-use technologies and is “anchored” to the China Ordnance Society’s Specialty Committee on Ballistics.<sup>61</sup>

Like the other MIIT universities, NJUST recruits experts globally. NJUST claims to have three “foreign academicians” on its faculty, eighteen selectees of the Changjiang Scholars Award Program, and

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60. “学校简介 [School Overview],” 南京理工大学 [Nanjing University of Science and Technology], 2020.

61. “学院简介 [School Overview],” 南京理工大学动力工程学院 [Nanjing University of Science and Technology School of Energy and Power Engineering], September 2019, <http://nd.njust.edu.cn/1845/list.htm>.



fourteen selectees of the Hundred, Thousand, and Ten-Thousand Talents Program.<sup>62</sup>

### *C. Survey of Scientific Publication Records*

A total of thirty-five articles were identified that contained coauthors from US institutions and NJUST. As NJUST's School of Energy and Power Engineering is engaged in weapons development, articles that listed authors affiliated with that division merit closer scrutiny. One of the authors appeared in six articles from this corpus. In addition, a secondary search of US funding sources named on NJUST-authored publications revealed one doctoral dissertation. No biographical information was found on its author, but the dissertation published at NJUST credits the US NSF for research support.

#### *Example: NJUST School of Energy and Power Engineering*

Publications with authors from NJUST's School of Energy and Power Engineering appeared in seven articles in the collected corpus along with US-based coauthors from the University of Minnesota, Twin Cities, the University of Michigan, and the University of Texas at Austin. Six of the seven publications had the same PRC coauthor.

One of them, published in 2016, includes a UT Austin faculty author, a NJUST faculty author, and a PhD student with both affiliations.<sup>63</sup> Although the article specifies that the student's NJUST affiliation was with the School of Energy and Power Engineering, that appears to have been a ruse. Two years earlier, the student published an article in the journal of another Seven Sons university entitled "An intelligent anti-removal system for blockade mines." The affiliation given in that article was the Ministerial Key Laboratory of Intelligent Ammunition under

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62. "学校简介 [School Overview]," 南京理工大学 [Nanjing University of Science and Technology], 2020.

63. Yujia Sun et al., "Evaluation of Three Different Radiative Transfer Equation Solvers for Combined Conduction and Radiation Heat Transfer," *Journal of Quantitative Spectroscopy & Radiative Transfer* 184 (2016): 262–73, <http://dx.doi.org/10.1016/j.jqsrt.2016.07.024>.

NJUST's School of Mechanical Engineering, and in 2019 the student in fact graduated from that school.<sup>64</sup>

The NJUST faculty author received a PhD in ballistics from NJUST in 1995. In 2002–03, he was a visiting scholar at Carnegie Mellon University pursuant to a PRC national study abroad program, which very likely refers to the CSC. In 2008, the researcher began serving as vice dean of the School of Energy and Power Engineering. He specializes in research related to interior ballistics theory and applications, multiphase flow theory and applications, and new types of point fire technologies.<sup>65</sup> He works on “preliminary national defense research” and was a recipient of the Eighth China Ordnance Society Youth Science and Technology Award.<sup>66</sup> Among his other distinctions, he is director-general of the China Ordnance Society's Specialty Committee on Ballistics, a standing member of the Jiangsu Academy of Military Industry, and a correspondent for the PRC *Journal of Artillery Launch and Control*.

In addition to the six articles in this corpus, this NJUST vice dean has coauthored other publications with purely PRC-based collaborators. Two of these articles directly relate to weapon designs (ballistics) and both name NJUST's National Key Laboratory of Transient Physics (瞬态物理国家重点实验室) as their funding source.<sup>67</sup>

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64. 孙宇嘉 [Sun Yujia], “封锁雷智能防排系统 [An Intelligent Anti-removal System for Blockade Mines], 哈尔滨工程大学学报 [Journal of Harbin Engineering University], 35, no. 5 (2014): 580–84, <http://doi.org/10.3969/j.issn.1006-7043.201303071>.

65. In 2008, the division was referred to as the School of Power Engineering.

66. The official award in Chinese is 第八届中国兵工学会青年科技奖. “能动学院教师简介—张小兵 [School of Energy and Power Engineering Professor-Zhang Xiaobing],” 南京理工大学动力工程学院 [Nanjing University of Science and Technology School of Energy and Power Engineering], March 11, 2015, <http://nd.njust.edu.cn/25/9c/c1905a9628/page.htm>.

67. 程诚 [Cheng Cheng] and 张小兵 [Zhang Xiaobing], “某制导炮弹二维两相流内弹道性能分析与数值模拟研究 [Two-Dimensional Numerical Simulation on Two-Phase Flow Interior Ballistic Performance of a Guided Projectile],” 兵工学报 [Acta Armamentarii] 36, no. 1 (2015): 58–63, <http://doi.org/10.3969/j.issn.1000-1093.2015.01.009>; 罗乔 [Luo Qiao] and 张小兵 [Zhang Xiaobing], “基于 FLU-

The National Key Laboratory of Transient Physics (NKLTP) began its operations in 1995 under COSTIND authorities and serves as NJUST's "research platform" for the "national key discipline of ordnance firing theory and techniques." Its website claims NKLTP has created an "interdisciplinary research system" of theoretical, fundamental, and applied research and information technologies related to ultra-high firing mechanics, flight dynamics, chemical kinetics, fluid dynamics, explosive mechanics, modern damage mechanics, guidance and control, plasma physics, engineering thermophysics, high simulation technology, and transient testing technologies. The laboratory claims that it has undertaken two hundred national scientific research projects and more than one hundred "other" projects, published more than seven hundred articles, and filed more than twenty patents. NKLTP has won a National Defense Science and Technology Prize, a National Defense Technology Invention prize, and an Army Science and Technology Progress award.<sup>68</sup>

## **V. Northwestern Polytechnical University: Collaboration with US Research Institutions**

### *A. Summary of Findings*

Northwestern Polytechnical University (西北工业大学, NWPU) runs education and research programs in aeronautics, astronautics, and marine technology engineering "dedicated to national defense," and it promotes military-civil fusion policies. NWPU's School of Aeronautics was formed from the former Harbin Military Engineering Institute and

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ENT 软件和内弹道模型双向耦合的超高射频火炮发射过程模拟 [Simulation for Launch Process of Ultrahigh Firing Rate Guns Based on Two-Way Coupling of FLUENT and Interior Ballistic Model], 兵工学报 [*Acta Armamentarii*] 37, no. 10 (2016): 1949–55, <http://doi.org/10.3969/j.issn.1000-1093.2016.10.023>.

68. "瞬态物理国家重点实验室 [National Key Laboratory of Transient Physics]," 南京理工大学瞬态物理国家重点实验室 [Nanjing University of Science and Technology National Key Laboratory of Transient Physics], December 12, 2019, <http://zdsys.njust.edu.cn/38/bb/c2552a14523/page.htm>.

is involved in “almost all major aircraft and spacecraft development of China,” including fighter jets, large transport aircraft, near space flight vehicles, and new-concept aircraft and drone projects.<sup>69</sup>

Supplemental information compiled on select authors and institutional affiliations, primarily from Chinese-language sources, demonstrates that some of the NWPU-based entities collaborating with US institutions oversee numerous defense research and engineering programs and develop potential surveillance capabilities for the People’s Armed Police (PAP). The PAP is a paramilitary police force under the direct authority of the CCP Central Committee and its Military Affairs Commission. The PAP performs domestic security and surveillance functions to support the CCP’s authoritarian control over the PRC population. NWPU is on the US Department of Commerce’s Entity List for export control purposes, but this may not limit collaboration with US institutions if the research is categorized as fundamental in nature.

- Several NWPU-affiliated coauthors have overseen PLA research projects, won National Defense Science and Technology Awards, and have been involved in projects that are likely classified weapons programs given the “XXX” designators in their project titles. Projects include research into computational software systems integration, high-speed wind tunnels, fluid dynamics, and aerodynamics.
- One article named a coauthor affiliated with a missile design and production subsidiary, CALT, which is subordinate to a major defense conglomerate, the China Aerospace Science and Technology Corporation (CASC).
- Another article named researchers from NWPU, a US university, and the Xi’an Engineering College of the People’s Armed Police, raising ethical concerns over the potential applications of this

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69. “Overview,” Northwestern Polytechnical University School of Aeronautics, Internet Archive, archived September 13, 2019, accessed June 15, 2020, <https://web.archive.org/web/20190913235933/http://hangkong.nwpu.edu.cn/home/overview/view.htm>.

research. No biographical data was found on the PAP-affiliated coauthor, raising questions about the background information the partnering US institution could have gathered about this individual.

- Several identified articles use incomplete or innocuous sounding English-language names for a defense laboratory in NWPU's School of Aeronautics in an apparent attempt to obfuscate its ties to defense programs.
- Four identified English-language articles list coauthors affiliated with US government institutions, including the NIH, the DoE, and the US Naval Research Laboratory (NRL). Although the research associated with these articles may be benign in nature, the NWPU coauthors are affiliated with departments that conduct defense research projects. Two other articles were found that credited NIH and NSF funding, yet these articles only appear in Chinese-language sources. Consequently, federal agencies may be unaware that research results were being published in the PRC.

### *B. Overview of NWPU and Support to the PRC's National Defense*

NWPU claims to be the only research institution in the PRC that simultaneously runs education and research programs in aeronautics, astronautics, and marine technology engineering. As an MIIT-designated Seven Sons university, NWPU's website states that it is "dedicated to national defense." NWPU is the result of several mergers of older schools and departments, in this case dating back to 1938. NWPU's current name was designated in 1957, having previously been named the Northwestern Institute of Engineering.<sup>70</sup> In addition, the PLA's Air Force Engineering Department of the former Harbin Military Engineering Institute was merged into NWPU in 1970 and is now part of NWPU's School of Aeronautics.<sup>71</sup>

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70. "History of NPU," 西北工业大学 [Northwestern Polytechnical University], accessed June 14, 2020, <http://en.nwpu.edu.cn/EnglishNew/AboutNPU/History.htm>.

71. "Overview," Northwestern Polytechnical University School of Aeronautics.

NWPU states that it was one of the first universities to establish a graduate school and a national university science park; it now hosts the Northwestern Institute of Industrial Technology and the PRC's top UAV (uncrewed aerial vehicle) Research and Development Base.<sup>72</sup> NWPU also houses eight state key laboratories, two national engineering research centers, four national and international S&T cooperation bases, one National Defense S&T Innovation Center, and eight "national defense innovation teams." These entities are involved in large aircraft, manned spaceflight, aerospace manufacturing engineering, flight mechanics, aero-engines, naval and submarine weapons, and rocket engines. NWPU also claims to hold an "important position in shipbuilding and naval weapons industries."<sup>73</sup>

The School of Aeronautics clearly plays a key role in NWPU's defense programs and touts well-known graduates of the school, such as: Yang Wei, chief designer of the PRC's "new-generation fighter aircraft;" Tang Changhong, chief designer of large aircraft; and Chen Yong, chief designer of the PRC's next-generation regional transport aircraft (the ARJ21). The school also claims that faculty and students have participated in "almost all major aircraft and spacecraft development of China," including the J7E (fighter jet), large transport aircraft, near space flight vehicles, and new-concept aircraft and UAV projects.<sup>74</sup>

NWPU also boasts that it houses the PRC's only national key laboratory for special drone technology and a national engineering center for drone systems. The university built Asia's largest satellite ground control station, the PRC's first small drone, and the first 50kg underwater autonomous vehicle.<sup>75</sup>

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72. "History of NPU," 西北工业大学 [Northwestern Polytechnical University], 2020.

73. "学校简介 [School Overview]," 西北工业大学 [Northwestern Polytechnical University], December 2019, <http://www.nwpu.edu.cn/xxgk/xxjj.htm>.

74. "学校简介 [School Overview]," 西北工业大学 [Northwestern Polytechnical University].

75. "学校简介 [School Overview]," 西北工业大学 [Northwestern Polytechnical University].

NWPU seeks to accelerate technology transfer and promotes military-civil integration policies. For example, NWPU has built platforms for collaboration with the PRC's major defense conglomerates, and in partnership with the Ministry of Science and Technology established an S&T Military-Civil Fusion Evaluation Research Center. Below the national level, NWPU also houses the Shaanxi (Provincial) Military-Civil Fusion Training Base and the Shaanxi Military-Civil Fusion Evaluation Center.<sup>76</sup>

NWPU is involved in considerable international collaboration efforts, claiming to have agreements with 280 schools overseas and ten national-level international cooperation platforms. These platforms include four national-level international S&T cooperation bases and six innovative talent introduction bases.<sup>77</sup>

NWPU is one of four Seven Sons universities on the US Department of Commerce's Entity List for export control regulation.

### *C. Survey of Scientific Publications*

Searches conducted on CNKI's website resulted in thirty-two publications having both NWPU and US-based coauthors. The majority of identified articles were in English, but the corpus includes several Chinese-language publications that merit further scrutiny.

Supplemental research on publications selected from the collected corpus of thirty-two articles reveals collaboration between US institutions and entities supporting PRC weapons development programs and the PAP.

#### ***Example 1: University of California–Irvine Collaboration with Researchers Associated with the PRC's Missile Programs, Presumably Classified Defense Projects***

A 2013 Chinese-language article entitled “Numerical Computation and Analysis of Flow Over a Conical Forebody at High Angle-of-Attack,”

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76. “学校简介 [School Overview],” 西北工业大学 [Northwestern Polytechnical University].

77. “学校简介 [School Overview],” 西北工业大学 [Northwestern Polytechnical University].

published in the PRC *Journal of Projectiles, Rockets, Missiles and Guidance*, names seven coauthors affiliated with the following institutions:<sup>78</sup>

1. National Defense Science and Technology Key Laboratory of Airfoil and Cascade Aerodynamics, NWPU
2. Beijing Research Institute of Near Space Aircraft Systems Engineering (北京临近空间飞行器系统工程研究所)
3. University of California–Irvine

Several coauthors and the two PRC institutions named in this article warrant closer scrutiny. The first institution listed, NWPU’s National Defense Science and Technology Key Laboratory of Airfoil and Cascade Aerodynamics (西北工业大学翼型/叶栅空气动力学国防科技重点实验室), was established in 1992 by COSTIND and NWPU.<sup>79</sup> This laboratory is part of NWPU’s School of Aeronautics and has two name variants. Some sources (on NWPU websites and scientific publications) remove the Chinese terms for “national defense science and technology” (国防科技) and replace it with “national” or “state” (国家), thereby referring to it in English as a “state key laboratory” instead.<sup>80</sup> In the collected corpus, there were two articles that used this variant, which *suggests a deliberate effort to obfuscate the laboratory’s ties to the PRC’s defense programs*.

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78. 王中一 [Wang Zhongyi] et al., “圆锥前体大攻角绕流的数值计算与分析 [Numerical Computation and Analysis of Flow Over a Conical Forebody at High Angle-of-Attack],” 弹箭与制导学报 [*Journal of Projectiles, Rockets, Missiles and Guidance*] 33, no. 3 (2013): 123–125, <http://doi.org/10.15892/j.cnki.djzdx.2013.03.044>.

79. “西北工业大学航空学院流体力学系（三系）简介 [Northwestern Polytechnical University School of Aeronautics Department of Fluid Mechanics (Three Departments) Overview],” 西北工业大学航空学院 [Northwestern Polytechnical University School of Aeronautics], January 6, 2017, <https://hangkong.nwpu.edu.cn/info/1368/8220.htm>.

80. For example, this NWPU page removes the words “national defense”: <https://hangkong.nwpu.edu.cn/info/1053/1309.htm>.



One of the coauthors of this article is a professor at NWPU's School of Aeronautics, who has served since 2015 as the deputy director of the Academic Committee of the National Defense Science and Technology Key Laboratory of Airfoil and Cascade Aerodynamics. This NWPU scientist specializes in aerodynamics and fluid mechanics research and has worked extensively on defense projects, including what appear to be classified weapons programs.<sup>81</sup> His NWPU faculty webpage highlights a number of defense projects, including these:

- 863 Programs (national high-tech research programs supporting defense research)
- National defense major fundamental research (国防重大基础研究)
- PLA General Armaments Department Key Fund (总装重点基金) projects
- Five “major projects” with “XXX” designators in their titles (likely referring to classified programs) involving computational software systems integration, high speed wind tunnels, fluid dynamics, aerodynamics
- Winner of a 2014 National Defense Science and Technology Award related to a high speed airfoil and wind tunnel project (also with an “XXX” designator)<sup>82</sup>

Another PRC-based collaborator is affiliated with the Beijing Research Institute of Near Space Aircraft Systems Engineering. This institute falls under CALT, indicated in the illustration (Fig. 1) of the Academy's organizational structure.

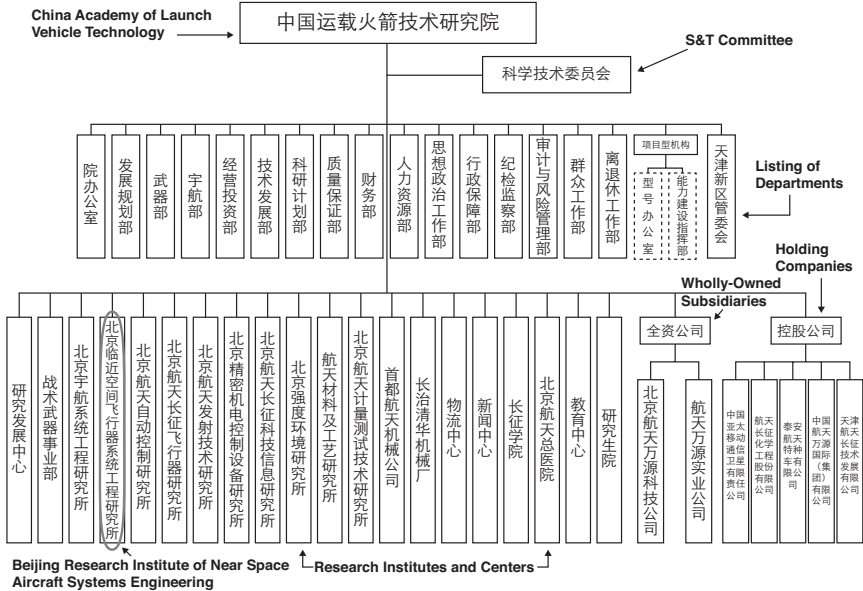
CALT is a missile design and production academy under the state-owned defense conglomerate CASC.<sup>83</sup> According to the Nuclear Threat

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81. “高超 [Gao Chao],” 西北工业大学 [Northwestern Polytechnical University], accessed June 14, 2020, <http://teacher.nwpu.edu.cn/gaochao.html>.

82. “高超 [Gao Chao].”

83. “China Academy of Launch Vehicle Technology (CALT),” Nuclear Threat Initiative, February 1, 1994, [www.nti.org/learn/facilities/59/](http://www.nti.org/learn/facilities/59/).



**Figure 1. China Academy of Launch Vehicle Technology organizational structure (with added English annotations). Source: “组织机构, [Organizational Structure]” 中国运载火箭技术研究院 [China Academy of Launch Vehicle Technology], accessed June 14, 2020, <http://www.calt.com/n481/n490/index.html>.**

Initiative, CALT is the PRC’s “largest, most important organization for the research, development and production of space launch vehicles (SLVs), liquid-fueled surface-to-surface missiles, and solid-fueled surface-to-surface and submarine-launched ballistic missiles.” The academy produces short-and medium-range ballistic missiles and intercontinental ballistic missiles.<sup>84</sup>

The participation of researchers from an NWPU defense laboratory and a component of the PRC’s missile design academy raises serious questions about the potential weaponization of this research and concerns about the nature of the collaboration between these researchers and their coauthors at the University of California, Irvine.

84. “China Academy of Launch Vehicle Technology (CALT).”

***Example 2: University of California–Merced Collaboration with NWPU and the PRC’s People’s Armed Police***

Another Chinese-language article raises potential national security and ethical concerns.<sup>85</sup> This article, published in 2013, lists four authors affiliated with NWPU, Xi’an Engineering College of the People’s Armed Police, Tianjin University, and the University of California–Merced.<sup>86</sup>

The primary author of this article serves as dean of NWPU’s School of Applied Mathematics. After receiving undergraduate, master’s and doctoral degrees from NWPU, this author served as a visiting researcher at Florida Atlantic University’s Applied Research Center, paid for by the PRC government-run CSC. He/she also spent time as a postdoctoral researcher at the University of Colorado Boulder. Some of the author’s research focuses on nonlinear random dynamics, broad cell mapping, path integral formulation, and finite difference and stochastic dynamics. Some of the author’s professional associations include serving on an advisory committee of the Ministry of Education’s Aerospace Professional Educators Association and the Chinese Society of Vibration Engineering.<sup>87</sup>

No biographical information was found on the other PRC-based coauthor affiliated with the Technical College of the Xi’an People’s Armed Police (西安武警技术学院).<sup>88</sup> According to the school’s website, its name was changed to the People’s Armed Police Engineering University (武警工程大学) in 2011. In June 2017 (after the identified article was published), the university was reorganized and merged with the

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85. 徐伟 [Xu Wei] et al., “胞映射方法的研究和进展 [Development and Study on Cell Mapping Methods]”, 力学进展 [Advances in Mechanics] 1, (2013): 91–100, [https://caod.oriprobe.com/articles/32319667/DEVELOPMENT\\_AND\\_STUDY\\_ON\\_CELL\\_MAPPING\\_METHODS.htm](https://caod.oriprobe.com/articles/32319667/DEVELOPMENT_AND_STUDY_ON_CELL_MAPPING_METHODS.htm).

86. 徐伟 [Xu Wei] et al., “胞映射方法的研究和进展 [Development and Study on Cell Mapping Methods].”

87. “徐伟 [Xu Wei],” 西北工业大学 [Northwestern Polytechnical University], accessed June 14, 2020, <http://jszy.nwpu.edu.cn/1978000010.html>.

88. The English name is how it was rendered in the referenced article, but the Chinese name more closely resembles “Xi’an People’s Armed Police Technology Institute.”

former People's Armed Police Ürümqi Command College (武警乌鲁木齐指挥学院).<sup>89</sup>

The implications of this collaboration between UC Merced, NWPU and a PAP institution are serious. The PAP school merged with an Ürümqi-based PAP training unit, which is located in the capital of the PRC's Xinjiang region. The PAP in Xinjiang is deeply involved in what many in the international community consider to be the most oppressive surveillance regime in the world, including widespread extrajudicial detentions and forced mass internments of ethnic Uyghurs in reeducation camps.<sup>90</sup> Similar to Example 1, given that this publication appeared in a PRC source and only in Chinese, it is unknown whether UC Merced was aware of this research collaboration. Regardless, this article substantiates the need for heightened due diligence over academic collaboration with the PRC.

### ***Example 3: Articles Involving Researchers at US Government Facilities***

The collected corpus includes four English-language articles that name coauthors affiliated with US government institutions: the NIH, the DoE, and the NRL. Table 3 lists the publication source, title, authors, and affiliated institutions.

It is beyond the scope of this chapter to determine if the research in these articles has military applications or has violated US export controls. A more fundamental question is at stake: should the US government collaborate on S&T research of any kind with scholars from an

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89. “武警工程大学简介 [Overview of the Engineering University of the People's Armed Police],” 武警工程大学 [Engineering University of the People's Armed Police], Internet Archive, archived November 5, 2019, accessed June 15, 2020, <https://web.archive.org/web/20191105035753/http://www.wjgcdx.com/zhongxuejianjie/daxuejianjie/2018-06-07/47.html>.

90. Maya Wan., “*Eradicating Ideological Viruses*”: China's Campaign of Repression Against Xinjiang's Muslims, (New York: Human Rights Watch, 2018), <https://www.hrw.org/report/2018/09/09/eradicating-ideological-viruses/chinas-campaign-repression-against-xinjiangs>.

**Table 3: NWPU Research Collaboration with US Government Institutions**

Title	Source / Year	PRC Organization	US Organizations	Other Organizations
Knowledge-Guided Robust MRI Brain Extraction for Diverse Large-Scale Neuroimaging Studies on Humans and Nonhuman Primates	PLOS ONE (2014)	School of Automation, NWPU	Neuroimaging Research Branch, National Institute on Drug Abuse, NIH; Department of Radiology and Biomedical Research Imaging Center, University of North Carolina at Chapel Hill	Department of Brain and Cognitive Engineering, Korea University
Supported Tetrahedral Oxo-Sn Catalyst: Single Site, Two Modes of Catalysis	Journal of American Chemical Society (2016)	NWPU	Chemical Sciences Division, Argonne National Laboratory; Chemical Engineering Department, Purdue University	
A New High-Order Spectral Difference Method for Simulating Viscous Flows on Unstructured Grids with Mixed-Element Meshes	Computers and Fluids (2019)	School of Astronautics, NWPU	National Wind Technology Center, National Renewable Energy Laboratory; Department of Mechanical and Aerospace Engineering, George Washington University	
Main $\alpha$ Relaxation and Slow $\beta$ Relaxation Processes in a La30 Ce30 Al15 Co25 Metallic Glass	Journal of Materials Science and Technology (2019)	School of Mechanics, Civil Engineering and Architecture, NWPU	Chemistry Division, NRL, Code 6120	Université de Lyon, France

institution that is on the Entity List, and more specifically who are from units of that institution known to participate in the defense programs of a strategic competitor? Perhaps NIH, DoE, and the Department of Defense did not know that these collaborations were taking place and would not have approved of them. Given that all four articles were published in English-language sources accessible online from US entities such as Elsevier and the NIH’s website, the pertinent affiliation data was readily discoverable.

**Table 4: Research Naming US Funding Support and NWPU Author Affiliation**

Title	Organizations	Source	Funding
基于超像素的多模态 MRI 脑胶质瘤分割 (Segmentation of Glioblastoma Multiforme from Multimodal MR Images Based on Superpixel)	Houston Methodist Research Institute; School of Automation, NWPU	Journal of Northwestern Polytechnical University, 2014	NIH Grant 5G08LM893
无线视频通信跨层资源分配及性能优化 (Cross-Layer Resource Allocation and Performance Optimization for Wireless Video Communication)	Software Engineering Depart, Shenzhen Institute of Information Technology); Graduate School at Shenzhen, Tsinghua University; School of Computer Science and Engineering, University of Electronic Science and Technology of China; School of Electronics and Information, NWPU; Department of Electrical and Computer Engineering, University of Missouri	Journal of University of Electronic Science and Technology of China, 2013	NSF Grant DBI-0529082, DBI-0529012; 51st Round of Postdoctoral Fund of China 2012M510453

*D. Secondary Search: US Research Funding*

The second set of searches of CNKI bibliographic records examined articles that named a US institution as providing funding support and at least one author affiliated with NWPU. Only two records were found published in 2013 and 2014, both of which were in Chinese. Table 4 provides the bibliographic information on these articles.

***Example 1: NWPU’s Apparent Collaboration on NIH-Funded Projects***

The first article in Table 4 credits the NIH as the sole funding source. It was published in Chinese in NWPU’s own scholarly journal in 2014.<sup>91</sup> One of the NWPU-affiliated authors is a professor at NWPU’s School

91. 苏坡 [Su Po] et al., “基于超像素的多模态 MRI 脑胶质瘤分割 [Segmentation of Glioblastoma Multiforme from Multimodal MR Images Based on Superpixels],” 西北工业大学学报 [*Journal of Northwestern Polytechnical University*] 32, no. 3 (2014): 417–22, <http://doi.org/10.3969/j.issn.1000-2758.2014.03.017>.

of Automation and has taught at NWPU since 1992. This professor's research areas include gas sensors and applications, integration testing techniques, noise and vibration measurement, and medical / biological imaging management. The scientist is also a member of the Chinese Society of Aeronautics and on the experimentation and testing expert committee of the Shaanxi Provincial Society of Aeronautics. He has received funding from the National Natural Science Foundation of China, aerospace science and technology funds, NWPU basic research funds, and other provincial and municipal sources.<sup>92</sup> No biographical information was found on the other NWPU-affiliated coauthor.

Here too, the NIH may not have been aware of all of the relevant facts. On its face, the research would appear benign, but in the absence of a robust vetting framework that is able to reliably detect and block funding of PRC-based projects with military or dual-use applications, prudence dictates barring collaborations with a PRC researcher who has defense-related expertise and furthermore works at a School of Automation that focuses on defense and aeronautical disciplines in a university that is on the Entity List.

***Example 2: NSF Funding to NWPU Defense Researchers***

The second article in Table 4 underscores how entangled many NWPU researchers are with defense research and funding streams tied to the PRC military. This article was published in the Chinese-language *Journal of the University of Electronic Science and Technology of China* in 2013 and credits two awards from the US NSF Division of Biological Infrastructure, as well as PRC postdoctoral research funds. One coauthor hailed from the University of Missouri.

Another coauthor is an associate professor at NWPU's School of Computer Science. At the time of this article's publication, this coauthor was completing his PhD studies at NWPU. NWPU's website states that he conducts research in areas such as vehicle networking

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92. “西北工业大学自动化学院 [Northwestern Polytechnical University School of Automation],” 西北工业大学自动化学院 [Northwestern Polytechnical University School of Automation], accessed June 14, 2020, <https://zdhxy.nwpu.edu.cn/info/1167/2565.htm>.

design and optimization, driver behavioral analysis and safety support systems, and autonomous systems integration. Notably, of the eleven major research projects listed on his faculty webpage, four of them involved national defense and probably classified projects. Examples include the following:

- A National Defense Science and Technology Innovation Special Zone Plan project relating to uncrewed group systems
- A National Defense Basic Scientific Research project described as “XXX software integration support techniques”
- A 12th Five-Year Plan Preliminary Research Project entitled “XXX polymorphic real-time computing platform”
- An 11th Five-Year Plan Preliminary Research Project described as “XXX distributed real-time calculation techniques”<sup>93</sup>

## **VI. Beijing Institute of Technology: Collaboration with US Research Institutions**

### *A. Summary of Findings*

The Beijing Institute of Technology (BIT, 北京理工大学) claims to have been the first institution of higher education in the PRC to specialize in defense industries and to have filed the most defense-related patents of any PRC higher education institution. Like its Seven Sons peers, BIT promotes military-civil fusion efforts.

- BIT’s School of Mechatronical [sic] Engineering (机电学院) pursues weapons development such as warhead design, uncrewed aerial and underwater vehicles, and corresponding systems. Two identified articles named researchers from a laboratory on explosion and shock physics that is subordinate to this BIT school and the Georgia Institute of Technology (Georgia Tech).

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93. “姚远 [Yao Yuan],” 西北工业大学 [Northwestern Polytechnical University], accessed June 14, 2020, <http://teacher.nwpu.edu.cn/2017010188.html>.



- Two BIT doctoral dissertations and one thesis credited US NSF as providing funding support. All three students also reported receiving PRC government funding via the CSC to study in the United States.

### *B. Overview of BIT and Support to the PRC's National Defense*

BIT's origins trace to around 1940 in Yan'an as a research academy. In 1949, the school relocated to Beijing, and after experiencing a few name changes, it assumed its current name in 1988. BIT's official (Chinese-language) website boasts that it is the first PRC institution of higher education to specialize in national defense industries. BIT also claims that more than 120 of its graduates have served as provincial-level or higher government / Communist Party officials or PLA generals and that another was the chief designer of the PRC's first nuclear submarine.<sup>94</sup>

BIT claims to have developed hardware such as high-altitude solid rockets, low-altitude radars, the first light tank, advanced military use information systems, and other national defense technologies. BIT also claims to have filed the most national defense-related patents of any higher education institution in the PRC. Furthermore, BIT is involved in "military-civil fusion and innovation development" (军民融合与创新发展) efforts that are key to the PRC's current military modernization policies. In short, BIT has a stated mission to transfer civilian research areas to defense applications. It claims cooperative agreements with seventy-one countries or regions and student exchange agreements with more than fifty universities.<sup>95</sup>

### *C. Survey of Scientific Publications*

Searches on CNKI's portal identified thirty-one articles that name at least one US institution and BIT. Supplemental research identified one additional article that likely supports PRC weapons development

94. "学校简介 [School Overview]," 北京理工大学 [Beijing Institute of Technology], June 2019, <http://www.bit.edu.cn/gbxxgk/gbxqzl/xxjj/index.htm>.

95. "学校简介 [School Overview]," 北京理工大学 [Beijing Institute of Technology].

programs. Examples of articles and their associated entities are profiled below.

***Example 1: Georgia Tech Collaboration with BIT Weapons Laboratory***

The most glaring example of research collaboration in support of PRC weapons programs are two articles by researchers affiliated with Georgia Tech's School of Materials Science and Engineering, and BIT's State Key Laboratory of Explosion Science and Technology (SKLEST). One article was published in May 2018, and the other (not found in CNKI) was published in July 2018, both by the same pair of PRC-based coauthors.<sup>96</sup>

One of the coauthors claimed affiliations with both BIT and Georgia Tech. This individual was a postdoctoral researcher at BIT around the time of the articles' publication.<sup>97</sup> He completed at least part of his graduate studies at Georgia Tech, which may explain the dual affiliation.<sup>98</sup>

The other PRC-based coauthor is the dean of BIT's School of Mechanical Engineering and a professor at SKLEST. This author conducts research on material dynamics behavior, explosives working and composite materials, numerical simulation of explosions and shocks, energetic materials damage theory, and explosion safety technologies. He is also vice chair of the China Ordnance Society Explosion and Safety Technology Expert Committee and a member of the society's Youth Work Com-

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96. Jianrui Feng et al., "Absence of 2.5 Power Law For Fractal Packing In Metallic Glasses," *Journal of Physics: Condensed Matter* 30, no. 25 (June 2018), <https://doi.org/10.1088/1361-648X/aac45f>; Jianrui Feng et al., "Existence of Fractal Packing in Metallic Glasses: Molecular Dynamics Simulations of  $\text{Cu}_{46}\text{Zr}_{54}$ ," *Physical Review B* 98, no. 2 (July 2018): 024201, <http://doi.org/10.1103/PhysRevB.98.024201>.

97. "我校 18 名博士后研究人员获第 65 批中国博士后科学基金面上资助 [Eighteen of Our School's Postdoctoral Researchers Were Funded by the 65<sup>th</sup> Batch of China Postdoctoral Science Fellowships]," 北京理工大学 [Beijing Institute of Technology], May 8, 2019, <http://renshichu.bit.edu.cn/xwtz/xw/147273.htm>.

98. "毕业生 [Graduates]," 北京理工大学冲击波物理与化学实验室 [Shock Physics and Chemistry Lab at Beijing Institute of Technology], September 13, 2018, <http://shock.bit.edu.cn/zncy/byxs/129358.htm>.

mittee. The professor oversees a number of PRC government-funded research programs under the National Natural Science Foundation as well as ten National Defense Scientific Research Projects.<sup>99</sup>

The School of Mechatronical Engineering is extensively involved in weapons and defense research programs at BIT. For example, some of the subordinate divisions within the school include the Agile Weapons Research Institute (灵巧武器研究所), the Underwater Uncrewed Vehicles Systems Research Institute (水下无人系统研究所), the Intelligent Robotics Institute (智能机器人研究所), and the UAV Flight Engineering Department (无人飞行工程系). Additionally, the school houses three national defense science and technology innovation teams involving “target detection and damage control,” “new concept warhead technologies,” and “micro UAV systems.”<sup>100</sup>

SKLEST is subordinate to BIT’s School of Mechatronical Engineering.<sup>101</sup> According to its website, SKLEST “involves the disciplines of weapons science and technology, mechanics, safety science and engineering, materials science and engineering, chemical engineering and technology, and chemistry. . . . Research areas include theory and application of energetic materials, explosion mechanics, damage theory and application, protective theory and technology, and explosion safety theory and assessment methods.”<sup>102</sup>

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99. “陈鹏万 教授 [Professor Chen Pengwan],” 北京理工大学冲击波物理与化学实验室 [Shock Physics and Chemistry Lab at Beijing Institute of Technology], June 21, 2011, <http://shock.bit.edu.cn/zncy/js/5731.htm>.

100. “2017 年多物理场国际会议在北京理工大学成功举行 [The 2017 International Conference of Multiphysics Was Held at the Beijing Institute of Technology],” 北京理工大学冲击波物理与化学实验室 [Shock Physics and Chemistry Lab at Beijing Institute of Technology], December 21, 2017, <http://shock.bit.edu.cn/xwtd/75518.htm>.

101. “科研机构 [Institutional Structure],” 北京理工大学 [Beijing Institute of Technology], accessed June 14, 2020, <http://smen.bit.edu.cn/kxyj/kygk/index.htm>.

102. “Introduction,” 爆炸科学与技术国家重点实验室 [State Key Laboratory of Explosion Science and Technology, Beijing Institute of Technology], January 4, 2017, <http://est.bit.edu.cn/english/about/introduction/index.htm>.

SKLEST claims to have hired five researchers through the Changjiang Scholars Program, two Thousand Talents Program “specially-appointed” professors, and three Thousand Talents Youth professors.<sup>103</sup> This means that at least ten SKLEST employees were recruited from overseas. It is not known if any came from the United States or if any of the coauthors identified here are PRC talent program selectees.

#### *D. Secondary Search: US Research Funding of BIT Students*

The second set of CNKI bibliographic searches examined articles that named a US institution as a funding source and at least one author affiliated with BIT. Three Chinese-language publications were identified, all of which were theses and dissertations published at BIT. These records appear in Table 5. Additional information on the authors appears below the table. All spent part of their graduate studies in the United States with funding from the PRC CSC and subsequently returned to BIT to complete their degrees. They also all cite support from the NSF in their theses.

The first author credits the PLA General Armament Department and the NSF for funding support in his master’s thesis. He received bachelor’s and PhD degrees in electronics engineering from BIT’s School of Information and Electronics. According to the student’s CV, he spent a year (2015–16) as a visiting researcher at the Department of Electrical and Computer Engineering at Temple University, funded by the CSC. His work on NSF-funded research may date to this time, and he may have ultimately applied that research towards fulfillment of his doctoral degree requirements. He also spent a year at the University of Edinburgh (UK), from 2017 to 2018. He is now an associate professor at the PRC’s Southeast University School of Information Science and Engineering and conducts research in areas such as artificial intelligence, radar signal processing, and image reconstruction in electrical tomography.<sup>104</sup>

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103. “实验室简介 [Overview of Laboratory],” 爆炸科学与技术国家重点实验室 (北京理工大学) [State Key Laboratory of Explosion Science and Technology (Beijing Institute of Technology)], May 6, 2016, <http://est.bit.edu.cn/sysgk/sysjj/index.htm>.

104. “Shengheng Liu [刘升恒],” accessed June 14, 2020, <https://sites.google.com/site/shenghengliu/>.

Table 5: Research Naming US Funding Support and BIT Author Affiliation

Title	Organization	Funding
稀疏分数傅里叶变换理论及其在探测中的应用 (Sparse Fractional Fourier Transformation and Its Applications in Exploration)	Beijing Institute of Technology (December 2016 master's thesis)*	National Natural Science Foundation of China; US NSF; PLA General Armament Dept. Preliminary Research Fund (国家自然科学基金; 美国国家自然科学基金; 总装预研基金)
新兴技术竞争情报挖掘方法研究 (The Competitive Technical Intelligence Methodology for Emerging Technology)	Beijing Institute of Technology (November 2015 PhD dissertation)†	National Software Science Fund; National Natural Science Foundation of China; US NSF (国家软科学; 国家自然科学基金; 美国国家自然科学基金)
新兴技术热点领域识别及技术路线图研究—以纳米导药系统为例 (Research on Hot Topic Identification and Technology—Roadmapping: A Case Study of Nano-Enabled Drug Delivery)	Beijing Institute of Technology (June 2015 PhD dissertation)‡	US NSF (美国自然科学基金)

\* 刘升恒 [Liu Shengheng], “稀疏分数傅里叶变换理论及其在探测中的应用 [Sparse Fractional Fourier Transform and Its Applications in Exploration]” (PhD diss., Beijing Institute of Technology, 2016), <http://new.oversea.cnki.net/KCMS/detail/detail.aspx?dbcode=CDFD&dbname=CDFDLAST2018&filename=1018811862.nh&v=Mjk4MThySVZGMjZGcnU1SDluS3JaRWJQSVI4ZVgxTHV4WVM3RGgxVDNxVHJXTTFGckNVUjdxZlIlZHBGeTNRVkw=>.

† 张巍 [Zhang Yi], “新兴技术竞争情报挖掘方法研究 [The Competitive Technical Intelligence Methodology for Emerging Technology]” (PhD diss., Beijing Institute of Technology, 2016), <http://new.oversea.cnki.net/KCMS/detail/detail.aspx?dbcode=CDFD&dbname=CDFDLAST2016&filename=1016710629.nh&v=MDg0MDI0Zk9wcEViUEISOGVYMUxteFITN0RoMVQzcVRyV00xRnJDVVI3cWZZZWRRwRnlyaFViLoFWRjl2R0xTNUg=>.

‡ 周潇 [Zhou Xiao], “新兴技术热点领域识别及技术路线图研究—以纳米导药系统为例 [Research on Hot Topic Identification and Technology Roadmapping: A Case Study of Nano-Enabled Drug Delivery]” (PhD diss., Beijing Institute of Technology, 2015), <http://new.oversea.cnki.net/KCMS/detail/detail.aspx?dbcode=CDFD&dbname=CDFDLAST2016&filename=1016706825.nh&v=MDM2MTBuT3FwRWJQSVI4ZVgxTHV4WVM3RGgxVDNxVHJXTTFGckNVUjdxZlIlZHBGeTNRVUx6TFZGMjZHTFM0R04=>.

One of the 2015 doctoral dissertations was filed by a student at BIT’s School of Management and Economics who spent a year (2011–12) at Georgia Tech through a “joint PhD training” program.<sup>105</sup> A brief biography in the dissertation states that the student’s visit to Georgia Tech was funded by the CSC. The student participated in an NSF-funded

105. “张巍 [Zhang Yi],” 北京理工大学管理与经济学院知识管理与数据分析实验室 [Knowledge Management and Data Analysis Laboratory, Beijing Institute of Technology School of Management and Economics], accessed June 14, 2020, [http://www.aaaa.org.cn/team\\_desc.asp?id=24](http://www.aaaa.org.cn/team_desc.asp?id=24).

symposium entitled “Revealing Innovation Pathways: Hybrid Science Maps for Technology Assessment and Foresight” with Georgia Tech, which may be related to the NSF funding credited in the dissertation.<sup>106</sup>

The second dissertation was written by a PhD candidate who received a bachelor’s and master’s degree at BIT. In 2007, she spent a year at the Illinois Institute of Technology. In 2012–13, she spent a year at Georgia Tech, funded by the CSC.<sup>107</sup>

## **VII. Beihang University: Collaboration with US Research Institutions**

### *A. Summary of Findings*

Beihang University (北京航空航天大学, previously known as Beijing University of Aeronautics and Astronautics) has been involved in defense aerospace-related research since shortly after the university’s founding in 1952. A significant subset of this research appears to focus on rocket engine design, missile design, and missile control systems. Beihang University appears to be heavily involved in defense research, as it claims to oversee 448 national defense research projects and 241 National 863 Program projects (which often involve military applications). This may be a key reason behind Beihang University’s placement on the Department of Commerce’s Entity List. The collected corpus reveals the following findings:

- One article with a coauthor from Beihang University also included a coauthor from the PLA’s National University of Defense Technology (NUDT).
- Researchers affiliated with DoE laboratories—Argonne National Laboratory and Oak Ridge National Laboratory—coauthored

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106. 张巍 [Zhang Yi].”

107. 周潇 [Zhou Xiao], 北京理工大学管理与经济学院知识管理与数据分析实验室 [Knowledge Management and Data Analysis Laboratory, Beijing Institute of Technology School of Management and Economics], accessed June 14, 2020, [http://www.aaaa.org.cn/team\\_desc.asp?id=146](http://www.aaaa.org.cn/team_desc.asp?id=146).

publications with Beihang University, raising concerns over the potential use of US federal government resources for this research.

- A researcher at Old Dominion University has collaborated on multiple research projects with Beihang University spanning at least six years, and one article was also coauthored by a researcher affiliated with an institute under the missile design and production facility CALT.
- One article involving researchers from US, Canadian, and PRC universities names coauthors from Beihang University and PRC telecommunications giant Huawei. The US government has placed Huawei on the Department of Commerce's Entity List. Huawei's participation in research collaborations that may have military significance between Beihang University and US institutions is therefore noteworthy.

### *B. Overview of Beihang University and Support to the PRC's National Defense*

Beihang University was founded on October 25, 1952 as the Beijing Institute of Aeronautics, which originated from the merger of the aeronautical departments of a number of other universities, including Tsinghua University, Beiyang University, Xiamen University, and Sichuan University. In 1956, it instituted the PRC's first degree programs for guided missiles, missile design, liquid rocket engines, and aerodynamics. The university subsequently developed programs for radio equipment, aeronautical engineering, and instrument technology. By 1959, it created programs for aeronautical nonmetallic materials, corrosion and surface protection, radio navigation, radar, telemetry, and two laboratories on rocket engines and missile control systems.<sup>108</sup>

Additional research programs followed, including airplane design, winged missile design, aircraft high-altitude equipment design, aircraft engine design, solid rocket engine design, aviation gyro instruments,

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108. "History," Beihang University, accessed June 14, 2020, <https://ev.buaa.edu.cn/About/History.htm>.

and inertial navigation.<sup>109</sup> Beihang University has also been involved in civilian aerospace fields (with dual-use potential); the main designers and chief engineers of the PRC's first manned space flight, the Shenzhou-5 Spacecraft, are Beihang alumni.

Beihang University highlights its successful recruitment of experts who have received training and/or work experience overseas. It hired twenty-seven selectees of the Recruitment Program of Global Experts "Innovative Talents" (a subcomponent of the PRC's flagship Thousand Talents Program), as well as fifty-eight selectees of the Thousand Talents youth component (also known as the Recruitment Program for Young Professionals). The university claims that it has recruited sixty-seven selectees of the Changjiang Scholars Award Program.<sup>110</sup> It has also joined with the elite *Écoles Centrales* network of graduate engineering schools in France to operate the Sino-French *École Centrale de Pékin*, which confers on its graduates both PRC and French degrees and integrates industrial training into the curriculum via Western corporate partners.

The website of the PRC's Ministry of National Defense (MND) offers other significant details on Beihang University's mission. MND confirms that the university was under the supervision of COSTIND, and the university was jointly sponsored by COSTIND, the Ministry of Education, the Beijing municipal government, and the Chinese Academy of Engineering. Additionally, Beihang University has two "national defense S&T innovation groups" and oversees 241 projects under the PRC's National High Technology 863 Program and 448 "national defense preliminary research projects" (国防预研项目).<sup>111</sup> Finally, it is a partner in the Collaborative Innovation Center of Astronautical Science and Technology, which also includes the China Aerospace Science

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109. "History," Beihang University.

110. "Beihang at a Glance," Beihang University, October 2017, [https://ev.buaa.edu.cn/About/Beihang\\_at\\_a\\_Glance.htm](https://ev.buaa.edu.cn/About/Beihang_at_a_Glance.htm).

111. "国防生招生院校介绍: 北京航空航天大学 [Introduction to National Defense College Admissions: Beihang University]," Ministry of National Defense of the People's Republic of China, June 3, 2008, [www.mod.gov.cn/service/2008-06/03/content\\_4085764.htm](http://www.mod.gov.cn/service/2008-06/03/content_4085764.htm).



and Technology Corporation (CASC), Peking University, and the University of Science and Technology of China.

### *C. Survey of Scientific Publications*

Searches on CNKI's portal identified twenty-eight articles that named coauthors from at least one US institution and Beihang University. Three of the articles merit closer scrutiny based on the affiliations of these coauthors.

- Two articles name coauthors from DoE: one article lists Argonne National Laboratory and the other names Oak Ridge National Laboratory.<sup>112</sup> The potential use of federal government resources or facilities to facilitate research collaborations with Beihang University is concerning in light of the university's presence on the Entity List. Further investigation is recommended to determine if: a) DoE facilities or resources were used to contribute to the published research results; b) whether leadership at the DoE laboratories were informed or consented to such collaboration; or c) whether Beihang University or a PRC government-funded program provided funding or compensation to the DoE-affiliated collaborators.
- Another article listed coauthors affiliated with the University of Illinois at Chicago, the University of Michigan, and the PRC's NUDT, in addition to Beihang University.<sup>113</sup> One of the coauthors claims a dual affiliation with Beihang and the University of Illinois, and another coauthor claims a dual affiliation with NUDT and the University of Michigan. NUDT is a university directly managed

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112. Yang Li et al., "Theoretical Kinetics Analysis for  $\dot{\text{H}}$  Atom Addition to 1,3-Butadiene and Related Reactions on the  $\dot{\text{C}}_4\text{H}_7$  Potential Energy Surface," *Journal of Physical Chemistry A* 121, no. 40 (September 2017): 7433–7445, <https://doi.org/10.1021/acs.jpca.7b05996>; Xiaojun Yan et al., "The Effects Of DS Blade's Geometry Features on Material's Creep Strength," *Propulsion and Power Research* 3, no. 3 (September 2014): 143–150, <https://doi.org/10.1016/j.jprr.2014.07.004>.

113. Yang Yang et al., "A Robust Method for Inferring Network Structures," *Scientific Reports* 7 (2017), <https://doi.org/10.1038/s41598-017-04725-2>.

by the PLA. These dual affiliations invite scrutiny of the US institutions' involvement.

Supplemental research was conducted on individuals and institutions associated with two other articles in the collected corpus and are profiled below.

***Example 1: Old Dominion University Collaboration with the PRC's Missile Programs***

The article of greatest concern was published in 2014 in the journal *Computers and Fluids* and has demonstrable connections to the PRC's missile programs.<sup>114</sup> Coauthors listed affiliations with the following institutions:

1. School of Energy and Power Engineering, Beihang University
2. Department of Mathematics and Statistics, Old Dominion University (Virginia)
3. Beijing Institute of Space Launch Technology

While Beihang's participation is sufficient to warrant concern, the addition of the Beijing Institute of Space Launch Technology (北京航天发射技术研究所) raises the risk profile of this collaboration substantially. The Beijing Institute of Space Launch Technology is a division of CALT (a missile design and production group profiled in Section IV on NWPU). Figure 2 depicts this organizational relationship, with the Beijing Institute of Space Launch Technology circled.

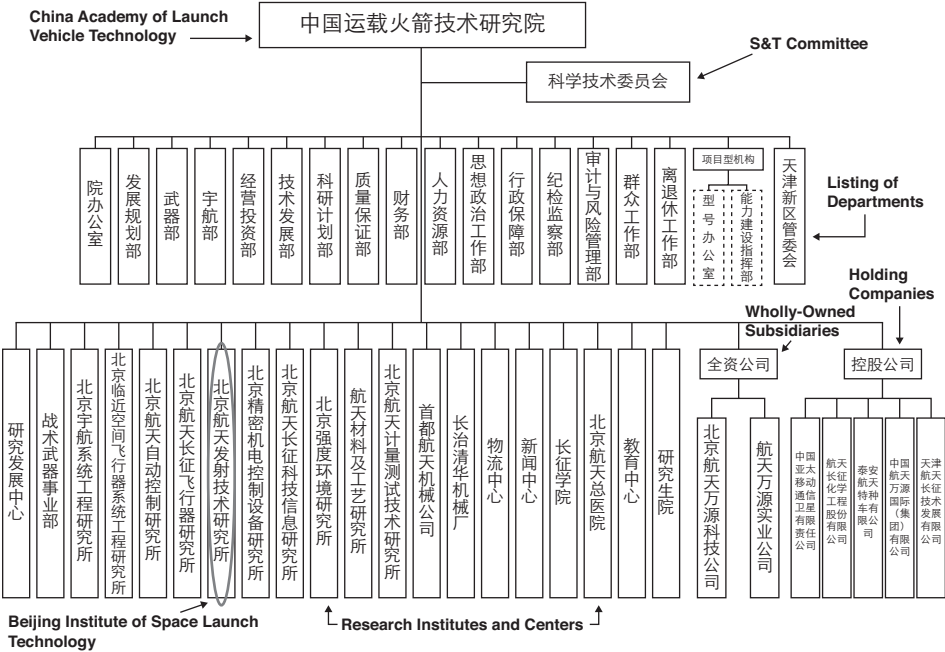
Supplemental research found two other articles coauthored by two of the same scientists listed in this article who are affiliated with Old Dominion University and Beihang University.<sup>115</sup> One article was published in 2010 and the other published in 2016, suggesting a long-standing research partnership.<sup>116</sup>

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114. Li Liu et al., "Nonuniform-Time-Step Explicit Runge–Kutta Scheme for High-Order Finite Difference Method," *Computers and Fluids* 105, (December 2014): 16678, <https://doi.org/10.1016/j.compfluid.2014.09.008>.

115. Note the additional articles did not appear in searches of CNKI's web portal.

116. 林大楷 [Lin Dakai] et al., "完全耦合层边界条件在圆柱绕流 DNS 中的应用 [Perfectly Matched Layer Boundary Conditions Using in DNS of Flow Around



**Figure 2. China Academy of Launch Vehicle Technology organizational structure (with added English annotations). Source: “组织机构, [Organizational Structure]” 中国运载火箭技术研究院 [China Academy of Launch Vehicle Technology].**

*Example 2: MIT Collaboration with Huawei Technologies*

A 2016 article in the collected corpus named coauthors affiliated with the Massachusetts Institute of Technology (MIT), Beihang University, PRC telecommunications giant Huawei, and several other PRC and Canadian universities.<sup>117</sup> Huawei’s involvement is noteworthy as the US government has since raised national security concerns over Huawei’s

Cylinder],” 工程热物理学报 [Journal of Engineering Thermophysics], (May 2010): 757–760; 徐希海 [Xu Xihai] et al., “复杂几何条件下伴随格林函数的数值求解 [Numerical Solutions of Adjoint Green’s Function for Complex Geometries],” 航空动力学报 [Journal of Aerospace Power], (April 2016): 927–933, <http://doi.org/10.13224/j.cnki.jasp.2016.04.020>.

117. Changqing Zou et al., “An Example-Based Approach to 3D Man-Made Object Reconstruction from Line Drawings,” Pattern Recognition 60, (December 2016): 543–553, <https://doi.org/10.1016/j.patcog.2016.05.031>.

potential global dominance in 5G technologies and suspected ties to the PRC government and PLA. The US Department of Justice has also issued multiple indictments alleging intellectual property theft, obstruction of justice, and fraud related to evasion of US sanctions against Iran.<sup>118</sup> In May 2019, the US Department of Commerce placed Huawei and its affiliates on the Entity List.<sup>119</sup>

The coauthors of this article published in the journal *Pattern Recognition* are affiliated with the following institutions:

1. Hengyang Normal University (PRC)
2. Simon Fraser University (Canada)
3. Massachusetts Institute of Technology
4. Shandong University (PRC)
5. School of Automation Science and Electrical Engineering, Beihang University (PRC)
6. Huawei Technology Co. Ltd. (PRC)

Elsevier's ScienceDirect also posted information on this article and included biographies of the coauthors.<sup>120</sup>

- Two of the coauthors studied at HIT and worked in remote sensing, image processing, and other computer science fields. One of

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118. US Department of Justice, Office of Public Affairs, "Chinese Telecommunications Device Manufacturer and its U.S. Affiliate Indicted for Theft of Trade Secrets, Wire Fraud, and Obstruction Of Justice," January 28, 2019, <https://www.justice.gov/opa/pr/chinese-telecommunications-device-manufacturer-and-its-us-affiliate-indicted-theft-trade>; Sean Keane, "Huawei Ban Timeline: NATO Head Supports UK Review of Chinese Firm's Role in 5G Rollout," CNET, June 10, 2020, <https://www.cnet.com/news/huawei-ban-full-timeline-on-how-and-why-its-phones-are-under-fire/>.

119. Bureau of Industry and Security, Commerce, "Addition of Entities to the Entity List," *Federal Register* 84, no. 98 (May 21, 2019): 22961, <https://www.federalregister.gov/documents/2019/05/21/2019-10616/addition-of-entities-to-the-entity-list>.

120. Zou et al., "An Example-Based Approach to 3D Man-Made Object Reconstruction from Line Drawings."

the HIT graduates held a research position at Griffith University in Australia and was subsequently recruited through a PRC Ministry of Education-sponsored recruitment program known as the New Century Excellent Talents to work at Beihang University.

- The Huawei-affiliated author claims to be a chief scientist specializing in computer vision, machine learning, image processing, and related artificial intelligence (AI) disciplines and previously worked at the Chinese Academy of Sciences Shenzhen Institutes of Advanced Technology.<sup>121</sup>

The apparent research collaboration with Huawei and Beihang University raises questions as to whether Huawei was developing military applications for this research or commercializing it for civilian purposes.<sup>122</sup>

## **VIII. Harbin Engineering University: Collaboration with US Research Institutions**

### *A. Summary of Findings*

The Harbin Engineering University (哈尔滨工程大学, HEU) has been an integral part of the PLA since its origins and has a strong focus on the development of PLA Navy technologies and equipment manufacturing such as naval nuclear power, underwater robotics, noise reduction, ship stabilization, marine propulsion, integrated navigation, hydro-location, subsurface detection, (ocean) surface drones, and nuclear power simulation.

- HEU's College of Nuclear Science and Technology conducts defense research and, according to the collected corpus of articles,

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121. Zou et al., "An Example-Based Approach to 3D Man-Made Object Reconstruction from Line Drawings."

122. In April 2019, MIT announced that it will no longer accept new or renew existing partnerships with Huawei and that collaborative projects will be subject to additional review ([http://orgchart.mit.edu/node/27/letters\\_to\\_community/new-review-process-elevated-risk-international-proposals](http://orgchart.mit.edu/node/27/letters_to_community/new-review-process-elevated-risk-international-proposals)).

partners with US institutions, including DoE laboratories and the University of Michigan. The English-language articles in the collected corpus obfuscate the associations of their coauthors with defense programs by referring to their institutional affiliations with innocuous sounding translations.

- One of the HEU-affiliated coauthors is involved in national organizations that promote military-civil fusion efforts on behalf of the PRC government and CCP.

### *B. Overview of HEU and Support to the PRC's National Defense*

The Harbin Engineering University's roots began with the founding of the PLA Military Engineering Institute (中国人民解放军军事工程学院) in 1953. In 1960–62, several departments were relocated to form the basis of other defense-related universities such as the (now named) Nanjing University of Science and Technology (another Seven Sons university) and the PLA's Institute of Chemical Defense. In 1966, the university changed its name to the Harbin Engineering Institute. In 1970, a Naval Engineering department was created and the university became known as the Harbin Shipbuilding Engineering Institute. Administration of the university then came under several machinery ministries and subsequently the China State Shipbuilding Corporation.<sup>123</sup> Other departments, such as Electronic Engineering, Missile Engineering, and Computer Engineering were transferred to what is now NUDT.<sup>124</sup>

In 1994, the university was renamed the Harbin Engineering University and administered by COSTIND. In 2007, the university was jointly (re)established by COSTIND, the Ministry of Education, the Heilongjiang provincial government, and the PLA Navy. HEU has played a key role in the PRC's military modernization, with a focus on naval technologies. HEU has seven MIIT-run national laboratories, two national defense key laboratories, ten “national defense special disciplines,” and

123. “学校简介 [School Overview],” 哈尔滨工程大学 [Harbin Engineering University], September 2019, <http://www.heu.cn/xygk/xxjj.aspx>.

124. “Our History,” Harbin Engineering University, accessed June 14, 2020, <https://english.hrbeu.edu.cn/5666/list.htm>.

seven “national defense urgently needed and key majors,” and serves as a military reserve officer training school.<sup>125</sup>

- HEU claims to have developed the PRC’s first experimental submarine, the first hydrofoil, the first ship-based computer, the first depth finder instrument, and other military equipment technologies.
- HEU serves as an “important talent cultivation and research base” for “3 marine and 1 nuclear fields” (三海一核)—referring to ship engineering, naval equipment, ocean exploration, and nuclear power applications.
- HEU conducts research on naval nuclear power, underwater robotics, noise reduction, ship stabilization, marine propulsion, integrated navigation, hydro-location, subsurface detection, (ocean) surface drones, and nuclear power simulation fields.
- HEU boasts that it is a “key organization for advanced technologies in PLA Navy equipment development and manufacturing” (海军先进技术装备研制的重点单位) and that it has received national recognition for high-technology weapons equipment development and engineering and aircraft carrier construction.<sup>126</sup>

HEU is also involved in international collaboration and talent recruitment. It boasts thirteen Thousand Talents Program selectees, four Changjiang Scholars Award Program professors, seven National Hundred, Thousand, Ten-Thousand Talent Project selectees (国家百千万人才工程), and six “national defense science and technology innovation teams.” These programs typically hire experts from abroad to lead or guide research programs. Lastly, HEU claims to have established “stable, cooperative relationships” with more than twenty-two countries and one hundred organizations including the University of California–Berkeley, the University of Michigan, the University of Southampton (UK), the

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125. “学校简介 [School Overview],” 哈尔滨工程大学 [Harbin Engineering University].

126. “学校简介 [School Overview],” 哈尔滨工程大学 [Harbin Engineering University].

University of Sydney (Australia), and the Bauman Moscow State Technical University.<sup>127</sup> In June 2020, HEU was added to the US Department of Commerce's Entity List for export control purposes, but this may not limit collaboration with US institutions if the research is categorized as fundamental in nature.<sup>128</sup>

### *C. Survey of Scientific Publications*

Searches in CNKI's web portal produced no Chinese-language publications affiliated with HEU and a US institution. The fifteen English articles identified originate from Elsevier, according to the CNKI records.

There are two articles with HEU-affiliated authors that also name researchers from the US DoE as well as the University of Michigan. One of these articles appears to involve US research on ocean-related energy development.<sup>129</sup> Assuming there are no intended military applications behind this research, the article nonetheless raises the recurring question of whether the DoE should fund research with potential commercial applications at institutions that are closely integrated into the defense establishment of a strategic competitor.

#### ***Example 1: Argonne National Laboratory, University of Michigan Collaboration with HEU***

Supplemental research was conducted on an article that named DoE's Argonne National Laboratory as one of the partnering institutions.

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127. “学校简介 [School Overview],” 哈尔滨工程大学 [Harbin Engineering University].

128. Bureau of Industry and Security, Commerce, “Addition of Entities to the Entity List, Revision of Entries on the Entity List,” *Federal Register* 85, no. 109 (June 5, 2020): 34495, <https://www.govinfo.gov/content/pkg/FR-2020-06-05/pdf/2020-10869.pdf>.

129. Hai Sun et al., “Flow-Induced Vibration of Tandem Circular Cylinders with Selective Roughness: Effect of Spacing, Damping and Stiffness,” *European Journal of Mechanics / B Fluids* 74, (March-April 2019): 219–241, <https://doi.org/10.1016/j.euromechflu.2018.10.024>.



That article was published in the June 2018 issue of *Annals of Nuclear Energy*,<sup>130</sup> and despite the apparent civilian orientation of the research, the collaboration with an HEU-affiliated researcher merits scrutiny. Specifically, that researcher claimed to be affiliated with both the Department of Nuclear Engineering and Radiological Sciences at the University of Michigan and the “Fundamental Science on Nuclear Safety and Simulation Technology Laboratory” at HEU.<sup>131</sup> He served as a visiting professor at the University of Michigan<sup>132</sup> and is currently an assistant professor and master’s student advisor in HEU’s College of Nuclear Science and Technology (CNST). Notably, the HEU faculty webpage shows his position title but leaves blank all other sections on work and education experience.<sup>133</sup>

### ***Background on HEU College of Nuclear Science and Technology***

The researcher’s affiliation with CNST raises questions. According to its English-language webpage, CNST was founded in 2005 and has been involved in “comprehensive research and development of nuclear power plants.” CNST developed “new research directions - reprocessing of nuclear fuel, radiation damage and materials, and decommissioning of nuclear facilities” and signed “comprehensive cooperation agreements” with more than twenty institutions, including the University Michigan, Texas A&M University, Kyoto University, Lancaster University (UK), the International Atomic Energy Agency, and domestically with China Institute of Atomic Energy, China National Nuclear Corporation, and

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130. Chen Hao et al., “Multi-Level Coarse Mesh Finite Difference Acceleration with Local Two-Node Nodal Expansion Method,” *Annals of Nuclear Energy* 116, (June 2018): 105–113, <https://doi.org/10.1016/j.anucene.2018.02.002>.

131. Hao et al., “Multi-Level Coarse Mesh Finite Difference Acceleration with Local Two-Node Nodal Expansion Method.”

132. Nuclear Engineering and Radiological Sciences, *Annual Report: September 1, 2016–August 31, 2017*, (Ann Arbor, MI: University of Michigan, 2017), <https://ners.engin.umich.edu/wp-content/uploads/sites/7/2018/07/ners-ar2017.pdf>.

133. “郝琛 [Hao Chen],” 哈尔滨工程大学 [Harbin Engineering University], accessed June 14, 2020, <http://homepage.hrbeu.edu.cn/web/haochen>.

China General Nuclear Power Group.<sup>134</sup> The HEU-affiliated researcher's visiting professorship at the University of Michigan and the dual affiliation claimed in the article may have been connected to one of these "cooperation agreements."

However, CNST's Chinese-language website lists five subdivisions that do not appear on the English-language website, including a national defense key laboratory and a SASTIND-sponsored innovation center. (Table 6)

The researcher in question lists his HEU affiliation as the "Fundamental Science on Nuclear Safety and Simulation Technology Laboratory." This is almost certainly a minor variant of the "Nuclear Safety and Simulation Key Discipline Laboratory" named on HEU's English-language webpage. However, the official (Chinese) name only lists one "key laboratory" associated with nuclear safety and simulation: the SASTIND Nuclear Safety and Simulation Technology National Defense Key Laboratory. The article is presumably referring to this defense laboratory and reproduces HEU's obfuscation of its connections to PRC national defense-associated entities in English-language sources.

The same HEU researcher is also involved in advancing the PRC government's military-civil fusion policies. In 2018, he was named a designee of a newly formed presidium of the Youth Alliance of the China Association of Science and Technology's Military-Civil Fusion Alliance.<sup>135</sup> The announcement of his selection appeared in a news story entitled "China Association of Science and Technology Military-Civil

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134. "Nuclear Science and Technology College Introduction," Harbin Engineering University, accessed June 14, 2020, <https://english.hrbeu.edu.cn/2017/1102/c5855a169731/page.htm>.

135. "中国科协军民融合学会联合体青年人才托举论坛在江门召开 [China Association of Science and Technology Military-Civil Fusion Alliance Young Talents Forum Convenes in Jiangmen]," 中国航空学会 [China Society of Aeronautics and Astronautics], November 23, 2018, <http://www.csaa.org.cn/a/tmp/zuzhigongzuo/2018/1123/2371.html>.

**Table 6: HEU College of Nuclear Science and Technology Subdivisions**

Subdivisions Listed on English Webpage*	Subdivisions Listed on Chinese Webpage† (English translation added)
National Scientific Innovation Team	核动力安全与仿真创新引智基地 (Nuclear Power Safety and Simulation Innovative Talents Introduction Base)
Ministry of Education-State Administration of Foreign Expert Affairs (SAFEA)	教育部核科学与技术虚拟仿真实验教学中心 (Ministry of Education Nuclear Science and Technology Virtual Simulation Experimental Teaching Center)
Nuclear Power Safety and Simulation Innovation Base	
Nuclear Safety and Simulation Key Discipline Laboratory	科技部核安全与仿真技术国际联合研究中心 (Ministry of Science and Technology Nuclear Safety and Simulation Technology International Joint Research Center)
Heilongjiang Provincial Key Laboratory of Radiation Technology	工信部核动力安全与仿真技术协同创新中心 (MIIT Nuclear Power Safety and Simulation Technology Collaboration Innovation Center)
	国防科工局核安全与仿真技术国防重点学科实验室 (SASTIND Nuclear Safety and Simulation Technology National Defense Key Laboratory)
	国防科工局“核动力技术国防科技工业创新中心 (SASTIND Nuclear Power Technology National Defense Science and Technology Industry Innovation Center)
	黑龙江省核科学与技术实验教学示范中心 (Heilongjiang Provincial Nuclear Science and Technology Experimental Teaching Demonstration Center)
	黑龙江省辐射技术高校实验室 (Heilongjiang Provincial Radiation Technology Higher Education Laboratory)
	黑龙江省核动力装置性能与设备重点实验室 (Heilongjiang Provincial Nuclear Power Equipment and Facilities Key Laboratory)

\* “Nuclear Science and Technology College Introduction,” Harbin Engineering University, accessed June 14, 2020, <https://english.hrbeu.edu.cn/2017/1102/c5855a169731/page.htm>.

† “学院简介 [School Overview],” 哈尔滨工程大学核科学与技术学院 [Harbin Engineering University College of Nuclear Science and Technology], accessed June 14, 2020, <http://cnst.hrbeu.edu.cn/1928/list.htm>.

Fusion Alliance Young Talents Forum Convenes in Jiangmen.”<sup>136</sup> The news article described the new members of this body as contributors to “promoting military-civil fusion S&T development and lifting up the future of [the PRC’s] national defense.”<sup>137</sup>

136. The original Chinese title is “中国科协军民融合学会联合体青年人才托举论坛在江门召开.”

137. See note 136.

The China Association of Science and Technology (CAST) claims to be the largest “nongovernmental organization” of S&T professionals in the PRC. Despite this claim, CAST also states that it serves as a “bridge that links the Communist Party of China and the PRC government to the country’s S&T community.” CAST is a subordinate organ of the Chinese People’s Political Consultative Conference, an apex organ of the United Front that institutionalizes the CCP’s cooptation of nonparty elites from all walks of life.<sup>138</sup>

The CAST Military-Civil Fusion Alliance consists of eleven PRC professional societies (which are all also under CAST). They are listed below.

- China Ordnance Society (中国兵工学会)
- Chinese Society of Aeronautics and Astronautics (中国航空学会)
- Chinese Society of Naval Architects and Marine Engineers (中国造船工程学会)
- Chinese Nuclear Society (中国核学会)
- Chinese Society of Astronautics (中国宇航学会)
- Chinese Institute of Electronics (中国电子学会)
- China Instrument and Control Society (中国仪器仪表学会)
- Chinese Society for Composite Materials (中国复合材料学会)
- China Institute of Navigation (中国航海学会)
- China Textile Engineering Society (中国纺织工程学会)
- Chinese Society for Optical Engineering (中国光学工程学会)<sup>139</sup>

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138. “Profile,” China Association for Science and Technology, accessed June 14, 2020, <http://english.cast.org.cn/col/col471/index.html>.

139. “中国科协军民融合学会联合体 [China Association of Science and Technology Military-Civil Fusion Alliance],” 中国科协军民融合学会 [China Association for Science and Technology], May 6, 2019, [http://www.cast.org.cn/art/2019/5/6/art\\_558\\_39761.html](http://www.cast.org.cn/art/2019/5/6/art_558_39761.html).

## **IX. Nanjing University of Aeronautics and Astronautics: Collaboration with US Research Institutions**

### *A. Summary of Findings*

The Nanjing University of Aeronautics and Astronautics (南京航空航天大学, NUAA) was founded in 1952 and focuses primarily on aerospace engineering disciplines. NUAA was placed under the authority of COSTIND in 2004 and is heavily involved in defense aerospace programs and in the development of UAVs. The university oversees ten “national defense special disciplines” and numerous national defense fundamental research projects and has won multiple national defense invention and progress awards.

- Two subdivisions named in the collected corpus of articles directly support defense research and weapons programs. The College of Aerospace Engineering houses a national defense key laboratory and oversees projects under the (formerly named) PLA General Armament Department. The College of Automation Engineering manages “weapons science and technology” research disciplines and claims to have graduated more than 1,100 students that are part of the “national defense system.”
- One of the publications involving hypersonic flight vehicle engineering research named a grant that describes an apparent collaborative relationship between NUAA and the PRC’s missile design and production entity CALT. A listed coauthor of the article oversees this joint hypersonics project.
- A doctoral dissertation published at NUAA credited the US NSF for research support, which may have been conducted during the author’s study abroad at Stanford University’s Department of Aeronautics and Astronautics.

### *B. Overview of NUAA and Support to the PRC’s National Defense*

NUAA was founded in 1952 and has focused on aerospace engineering throughout its history. In 2004, COSTIND took over oversight of the

university. NUAA's English-language webpage notes that the university "will deeply implement the national innovation-driven development strategy and the military-civilian integration development strategy . . . in aeronautics, astronautics and aviation."<sup>140</sup>

Chinese-language descriptions on NUAA's website note that the university has a National Defense Science and Technology Industry Technology Research Applications Center (国防科技工业技术研究应用中心) and manages ten "national defense special disciplines." NUAA claims that "in national defense fields, NUAA has participated in advanced research, addressed key technology problems, and conducted experimental research on nearly every major aerospace model." Some of NUAA's noted achievements are production of the PRC's first large uncrewed target drone, the first uncrewed nuclear materials testing drone, the first uncrewed helicopter, the first uncrewed micro aircraft, and the successful launch of an independently developed microsatellite. NUAA also claims to have provided input into many of the technologies behind the PRC's Chang'e 3 robotic lunar surface exploration mission and related aerospace engineering projects.<sup>141</sup>

The Chinese-language website of NUAA's College of Aerospace Engineering states that the college is involved in military-related aircraft research and has a Study Discipline and Scientific Research Secrecy Protection Office, suggesting that some of the research may involve classified programs. Additionally, the college houses the National Defense Key Laboratory of Precision Drive Technology (精密驱动技术国防重点学科实验室), which is subordinate to NUAA's Ultrasonic Motor Research Center. This defense key laboratory was established in 2007 under COSTIND authorities. Interestingly, the Ultrasonic Motor Research Center was endorsed and established as a Ministry of Education and State Administration of Foreign Expert Affairs (SAFEA) Higher

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140. "NUAA's History," Nanjing University of Aeronautics and Astronautics, accessed June 14, 2020, <http://iao.nuaa.edu.cn/nuaas-history/>.

141. "南航简介 [Overview of NUAA]," 南京航空航天大学 [Nanjing University of Aeronautics and Astronautics], accessed June 14, 2020, <http://www.nuaa.edu.cn/479/list.htm>.

Education Innovative Talent Introduction Base (高等院校学科创新引智基地). SAFEA is a PRC central government organ in charge of recruiting experts worldwide to facilitate transfers of technology and intellectual capital.<sup>142</sup> The center is involved in seventeen national defense fundamental research projects and “[the former] PLA General Armament Department key projects.”<sup>143</sup>

NUAA’s College of Automation Engineering is also involved in defense research and engineering programs, despite no indication of this on its English-language webpage. The Chinese-language website notes that the college has two “national defense special majors” and that it has been recognized for outstanding contributions to national defense projects, including: one project winning second prize and another winning third prize in the “National Defense Technology Invention Award”; three projects winning second prize and one project winning third prize in the “National Defense Science and Technology Progress Award”; one individual recognized among the “national defense science and technology industry 100 outstanding doctorates”; and three individuals recognized as a “COSTIND outstanding PhD graduate.” Additionally, the College of Automation Engineering claims to have graduated more than 1,100 students who are part of the “national defense system.” The college is engaged in weapons science and technology research, and its website provides documents on “required materials for NUAA classified scientific research project management work processes” (南京航空航天大学涉密科研项目管理各业务流程所需材料).<sup>144</sup>

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142. SAFEA (国家外专局) was an organ directly under the PRC State Council but was later absorbed as a subordinate division of the Ministry of Science & Technology.

143. “精密驱动技术国防重点学科实验室,” Nanjing University of Aeronautics and Astronautics College of Aerospace Engineering, accessed June 14, 2020, <http://aero.nuaa.edu.cn/2017/0224/c9603a78292/page.htm>.

144. “南京航空航天大学涉密科研项目管理各业务流程所需材料,” 南京航空航天大学自动化学院 [Nanjing University of Aeronautics and Astronautics School of Automation], accessed June 15, 2020, <http://cae.nuaa.edu.cn/5410/list.htm>.

### *C. Survey of Scientific Publication Records*

Searches in CNKI resulted in only five identified science and engineering articles that had coauthors from US institutions and NUAA, the smallest set of results among the Seven Sons universities. A secondary search of US funding sources named on NUAA-authored publications resulted in one doctoral dissertation that credits the US NSF for support. All six publications were in the Chinese language, a unique finding among the universities profiled in this chapter. The reasons for such a low number of articles and the absence of any English-language publications among them are unknown. Two of the articles that named authors affiliated with NUAA's colleges of Aerospace Engineering and Automation Engineering are profiled below and document the coauthors' connections to PRC defense programs.

#### ***Example 1: NUAA College of Aerospace Engineering Collaboration with University of Texas at Arlington***

A 2016 publication entitled "Motion Around Vortices and  $\Lambda$  Vortex Rings in Boundary Layer Transition" named two authors affiliated with NUAA's College of Aerospace Engineering and one from the University of Texas at Arlington.<sup>145</sup> No biographical information was found on the primary coauthor affiliated with NUAA.<sup>146</sup> The second NUAA-affiliated coauthor is a professor and doctoral advisor who conducts research in computational fluid dynamics. His CV on NUAA's website mentions his past and current affiliations but lacks details on current research areas. The CV states that he was a second prize winner of the 2006 National Defense Science and Technology Award and currently

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145. 王义乾 [Wang Yiqian] et al., "平板湍流转捩过程中 $\Lambda$ 涡和环状涡的周围流场研究 [Motion Around Vortices and  $\Lambda$  Vortex Rings in Boundary Layer Transition]," 航空计算技术 [Aeronautical Computing Technology] 46, no. 2 (2016): 15–18, <https://kns.cnki.net/kcms/detail/detail.aspx?filename=HKJJ201602004&dbcode=CJFQ&dbname=CJFD2016&v=>.

146. It is possible this individual was a graduate student at the time of publication, which may explain the lack of additional biographical information.



oversees “national defense fundamental research projects.”<sup>147</sup> Baidu Baike hosts a more complete biography of the professor and lists “national defense preliminary research projects” he has worked on at NUAA. Examples include numerical simulation methods involving fluid dynamics, helicopter rotor aerodynamics, and aircraft complex form factor high precision aerodynamics.<sup>148</sup>

***Example 2: NUAA College of Automation Engineering Collaboration with University of Virginia on Near Space Hypersonic Vehicle Research***

An article of obvious national security concern within the corpus of NUAA articles is a 2018 publication discussing hypersonic vehicles, which the PLA seeks to develop to counter US military dominance. The article entitled “Research Progress of Adaptive Control for Hypersonic Vehicle in Near Space” named three authors affiliated with NUAA and one author affiliated with the University of Virginia.<sup>149</sup> Supplemental information obtained on two of the coauthors confirm their extensive work on PRC defense projects and weapons systems.<sup>150</sup> Additionally, the article names a research funding source associated with an apparent collaborative effort between NUAA and the missile production and design entity CALT.

The College of Automation Engineering website lists several “weapons science and technology” (兵器科学与技术) disciplines and faculty assigned to those disciplines. Two of the article’s coauthors are assigned

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147. “赵宁 [Zhao Ning],” 教师个人主页 [Faculty Pages], 南京航空航天大学 [Nanjing University of Aeronautics and Astronautics], accessed June 15, 2020, [http://faculty.nuaa.edu.cn/zn1/zh\\_CN/index.htm](http://faculty.nuaa.edu.cn/zn1/zh_CN/index.htm).

148. “赵宁 [Zhao Ning],” 百度百科 [Baidu Baike], accessed June 15, 2020, <https://baike.baidu.com/item/%E8%B5%B5%E5%AE%81/17017884>.

149. 甄子洋 [Zhen Ziyang] et al., “基于自适应控制的近空间高超声速飞行器研究进展 [Research Progress of Adaptive Control for Hypersonic Vehicle in Near Space],” 宇航学报 [Journal of Astronautics] 39, no. 4 (April 2018): 355–367, <http://doi.org/10.3873/j.issn.1000-1328.2018.04.001>.

150. The third NUAA-affiliated coauthor appears to be a graduate student based on an announcement of candidates accepted into an NUAA master’s degree program (<http://cae.nuaa.edu.cn/2016/0919/c5375a92404/page.htm>).

to the “weapon systems and applications engineering disciplines” within the college. Other weapons science disciplines within the same department include weapons firing theory / techniques, and artillery, automatic weapons, and ammunition engineering.<sup>151</sup>

The College of Automation Engineering hosts CVs for both coauthors on its faculty webpages. The first is a professor and vice dean of the college’s graduate school, where he conducts research on carrier-based aircraft, large passenger aircraft, hypersonic flight vehicles, drones/UAVs, and aircraft guidance and control. This researcher has overseen 863 Program topics and PLA Air Force Equipment Development Department preliminary research projects.<sup>152</sup>

The second coauthor is also a professor and vice dean of the College of Automation Engineering and conducts research on carrier-based aircraft and UAV take-off (from ships) guidance and control, drone swarm formation coordination, control and strategic decision making, hypersonic flight vehicles, fighter aircraft, large passenger aircraft, guided missiles, and related advanced flight controls. From February 2015 to February 2016, he was a visiting scholar at the University of Virginia’s Department of Electronic and Computer Engineering, where a third coauthor had an affiliation.

Furthermore, the second coauthor’s CV notes coauthorship of numerous Chinese- and English-language publications, many of which relate to drones/UAVs and aircraft carrier-related technologies. Some examples include the following:

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151. “兵器科学与技术 [Weapons Science and Technology],” 南京航空航天大学自动化学院 [Nanjing University of Aeronautics and Astronautics School of Automation], Internet Archive, archived September 7, 2019, accessed June 15, 2020, <https://web.archive.org/web/20190907133433/http://caegl.nuaa.edu.cn/list/471>.
  152. “江驹 [Jiang Ju],” 南京航空航天大学自动化学院 [Nanjing University of Aeronautics and Astronautics School of Automation], Internet Archive, archived September 13, 2019, accessed June 15, 2020, <https://web.archive.org/web/20190913213002/http://caegl.nuaa.edu.cn/showSz/471-1073>.

- “Self-Organization Method for Multiple Reconnaissance - Attack UAVs under Adversarial Environment,” *Aerospace Science and Technology*, 2016.
- “Observer-based backstepping longitudinal control for carrier-based UAV with actuator faults,” *Journal of Systems Engineering and Electronics*, 2017.
- “Multivariable Adaptive Distributed Leader-Follower Flight Control for Multiple UAVs Formation,” *The Aeronautical Journal*, 2017.
- “Take-off and Landing Control for a Coaxial Ducted Fan Uncrewed Helicopter,” *Aircraft Engineering and Aerospace Technology*, 2017.
- “Modeling, Control Design and Influence Analysis of Catapult-Assisted Take-Off Process for Carrier-Based Aircrafts,” *PIME Part G: Journal of Aerospace Engineering*, 2018.
- “Cooperative Search-Attack Mission Planning for Multi-UAV Based on Intelligent Self-Organized Algorithm,” *Aerospace Science and Technology*, 2018.

Additionally, this coauthor claims to have won several defense-related awards, including four separate “National Defense Science and Technology Progress Awards” in 2010, 2011, 2012, and 2017. These awards related to aircraft guidance and control techniques, load simulators, aircraft carrier technologies, and ship-based drone technologies. Lastly, this coauthor has managed research projects involving near space flight vehicle control techniques and what appears to have been the “CASC First Academy Higher Education Joint Innovation Fund” (航天一院高校联合创新基金) grant that funded the collected article on hypersonic flight vehicle controls at issue here.<sup>153</sup>

The bibliographic record belonging to that article lists the “First Academy Higher Education Joint Innovation Fund (CALT201603)” as a

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153. “甄子洋 [Zhen Ziyang],” 南京航空航天大学自动化学院 [Nanjing University of Aeronautics and Astronautics School of Automation], Internet Archive, archived September 14, 2019, accessed June 15, 2020, <https://web.archive.org/web/20190914053954/http://caegl.nuaa.edu.cn/showSz/471-1060>.

funding source.<sup>154</sup> The “CALT” prefix in the funding code refers to the China Academy of Launch Vehicle Technology, profiled above. CALT is also known as the CASC First Academy (中国航天科技集团有限公司第一研究院, or “航天一院” for short).<sup>155</sup> In short, the extensive defense research undertaken by both NUAAs coauthors, coupled with their apparent partnership with CALT, suggests that the research in the identified article may be intended for military-use hypersonic vehicles.

#### *D. Secondary Search: Claimed US Funding Support to NUAAs Dissertation*

A second set of searches of CNKI bibliographic records identified one doctoral dissertation published in 2016 at NUAAs that credits the US NSF for funding support. According to an announcement on NUAAs website, the author<sup>156</sup> was approved for a six-month study at Stanford University, and a Stanford University page confirms that he was a visiting student at the Structures and Composites Laboratory at the university’s Department of Aeronautics and Astronautics.<sup>157</sup> Assuming his only affiliation in the US was at Stanford, then it is reasonable to conclude he was involved in an NSF-funded research project there and incorporated that into his doctoral studies at NUAAs. He was a

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154. The funding information was only listed in Chinese, as “一院高效联合创新基金 (CALT201603).”

155. “本院概况 [School Overview],” 中国运载火箭技术研究院 [China Academy of Launch Vehicle Technology], accessed June 14, 2020, <http://www.calt.com/n481/n489/index.html>.

156. No English appears in the dissertation. An approximate translation of the title is “Research on Adaptive Tracking Techniques of Delayed Nonlinear System Parameter Identification and Damage Detection” (基于自适应追踪技术的迟滞非线性系统参数识别与损伤检测研究).

157. “关于公布博士生出国短期访学项目资助名单的通知 [Announcement of the Publication of the List of Funded Doctoral Candidates in the Short-Term Study Abroad Program],” 南京航空航天大学研究生院 [Nanjing University of Aeronautics and Astronautics Graduate School], March 17, 2014, <http://www.graduate.nuaa.edu.cn/2014/0317/c2146a52124/page.htm>.; “Tengfei Mu,” Stanford Engineering Structures and Composites Laboratory, <http://web.stanford.edu/group/sacl/people/mu.html>.

nominee for the 2018 “Most Beautiful Commercial Flyer” (最美商飞人) award for his work as a manager at the Shanghai Aircraft Design and Research Institute of the Commercial Aircraft Corporation of China (COMAC), China’s leading contender to break the grip that Boeing and Airbus have on the global market for widebody commercial aircraft.<sup>158</sup>

## **X. Conclusions and Recommendations**

The surveyed scientific publications reveal not just collaboration between US research institutions and PRC defense-affiliated entities, but also pathways through which those entities can build their human capital, harvest US S&T research at its source, and divert it to PRC defense research and weapons program development. The risks to national security are serious since such diversions could erode or eliminate US military superiority with lethal consequences in the event of an armed conflict. Regardless of whether US-based researchers or their employing institutions intend such an outcome, S&T collaborations with the PRC’s Seven Sons universities have jeopardized the integrity and security of US research and the federal funding that supports it. The US research enterprise does not have these problems in hand, despite repeated assurances to the contrary.

It is beyond the scope of this chapter to determine if US university administrators wittingly authorized any of the research collaborations reported in the collected corpus or if any prior vetting or approval procedures were followed. To the extent that any research identified in this corpus was considered fundamental in nature, it may not have violated US export control laws or been subject to other regulatory controls that would have restricted the underlying collaborations. Moreover, if US-based researchers failed to disclose foreign collaboration

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158. “‘携手筑梦·感动有你’ 2018 年度最美商飞人来了 [‘Working Together to Build Dreams, Moving You’: The Most Beautiful Commercial Flyer of 2018 Is Here],” 中国航空新闻网 [China Aviation News Network], January 28, 2019, <http://www.cannews.com.cn/2019/0130/189051.shtml>.

(e.g., as required by US employers or by federal granting agencies), those omissions may amount to administrative or regulatory noncompliance rather than unlawful activity.

Profiles of the seven PRC universities and related entities reveal a host of concerns, some of which are common to most or all of the universities. Examples include:

- Although many articles in the corpus are English-language publications, the most revealing information on the PRC-based entities came from Chinese-language sources. This complicates the efforts by US research institutions and government agencies to evaluate risks to research partnerships with the Seven Sons universities.
- Likewise, some of the Seven Sons universities host subdivisions and national laboratories that conduct defense research using innocuous-sounding English names, and/or provide sparse information on their structures or missions in English-language sources. This obfuscation of ties to PRC defense programs inhibits the ability of US institutions to conduct adequate due diligence on partnerships.
- All of the Seven Sons universities state that they promote or implement national military-civil fusion policies. Consequently, US institutions should assume that these universities actively seek ways to develop defense applications in otherwise benign research fields, creating risk assessment challenges.
- Many of the Seven Sons universities have documented partnerships with PLA entities and/or oversee classified programs on behalf of the PRC government.
- Several of the Seven Sons universities have partnerships with the PRC's defense industrial base, including state-owned weapons design and production conglomerates, which may lead to additional economic concerns over potential future intellectual property rights, patents, etc.
- Five of the Seven Sons universities (HIT, NWPU, BIT, NUAU, and NJUST) published graduate theses and dissertations that

credit US government funding support. The authors were visiting students at US institutions and were typically funded by the CSC. This raises questions about whether a) the PRC government is intentionally placing students into key US research programs to gain access to federally funded research; and b) whether US institutions should be training students from institutions that are closely tied to the PRC military and who may incorporate the research that they pursue in the United States into PRC programs that could adversely impact US national security.

Robust implementation of Presidential Proclamation 10043 will make future collaborations with Seven Sons affiliates of the sort documented in this chapter more difficult. But to declare victory and move on would be hasty. Our findings stand as monuments to a colossal failure of vision that has prevented the US research enterprise from appreciating the risks that such collaborations posed and from adopting appropriate safeguards of its own accord. Too little has changed in that regard, and many of the same vulnerabilities persist.

The next chapter moves beyond the empirical record established here to propose a new paradigm for preserving research integrity and security from the perspective of active members of the academic research community. For the purposes of closing out this chapter, we therefore offer a limited set of recommendations that hew closely to our findings.

### *1. Expand the scope of this report.*

- Other articles within the collected corpus merit scrutiny to identify potential risks to US entities. Further studies using the methodology detailed in the Appendix may identify US research collaborations with other PRC institutions that support the PRC's defense programs, especially those beyond the immediate compass of Presidential Proclamation 10043. This methodology could also be applied to collaborations with institutions and researchers from other nations.

- The economic implications of US-China research collaboration should be explored more fully. As PRC universities have partnerships with state-owned enterprises in both civilian and military sectors, further investigation is needed to determine if US taxpayers are funding technologies that are patented or commercialized by PRC universities or partner companies.

## *2. Expand vetting and due diligence of collaborations with PRC partners.*

- US research institutions should determine if the US-based coauthors were recipients of or worked on federal grants that related to the research published in the scientific literature this report identifies.
- US research institutions should compile information on all PRC organizations that have demonstrable connections to the PRC's defense research and industrial base. They should obtain this information primarily through PRC-based vernacular information sources and create collective information sharing mechanisms that can be used to enhance vetting of visiting PRC students and scholars, as well as ramp up due diligence on proposed or existing research partnerships with the PRC.
- US research institutions should partner / share information with foreign allies to enhance those nations' due diligence and risk assessments since the PRC's Seven Sons universities collaborate with many nations, not just the United States.

## *3. Enhance administrative oversight.*

- Benign research cannot be separated a priori from potential dual-use applications conducted at foreign institutions that support defense research such as the Seven Sons universities. US research institutions should mandate disclosures and preapprovals for all forms of S&T collaboration with PRC institutions—even when the research is considered fundamental in nature or published openly—and undertake disciplinary measures when individuals fail to seek approvals. Effective oversight depends on comprehensive reporting and periodic review.



*4. Create or revise common moral and ethical standards with respect to research collaboration in academia.*

- US research institutions should create a common framework to determine when research collaborations, student and researcher exchanges, and other forms of partnership may contribute to the military or domestic repressive capabilities of authoritarian regimes, violate democratic values or human rights, or involve unethical research practices.
- US research institutions should develop, maintain, and share lists of foreign partners (distinct from governmental lists) that they consider off limits for collaboration based on agreed-upon standards and documented evidence of programs, activities, or associations that are inimical to US interests and values.

## APPENDIX TO CHAPTER 1

# Sources and Methodologies

Academic literature is a rich but underutilized resource for investigating PRC science and technology (S&T) organizations, researchers, and programs. While some studies have focused on international publications in the English language, Chapter 1 identifies publications tied to PRC defense and weapons programs that have appeared in English-*and* Chinese-language sources. Scrutiny of both language spaces is essential to enhancing our understanding of not just the nature and scale of S&T research in the PRC, but also the risks that it may pose to US national security and economic interests and the integrity of the research conducted at US institutions.

The chapter surveys S&T collaborations between US research institutions (academia and government laboratories) and seven PRC universities that have the core mission of supporting the PRC's defense research and industrial base (the "Seven Sons of National Defense" 国防七子). By searching online bibliographic metadata, it assembles a corpus of English- and Chinese-language S&T publications with coauthors from one or more of the Seven Sons universities and at least one US institution. That metadata comprises article title, authors, affiliated institutions, publication source or date, and funding information (when available).

This methodology is generalizable. It can be applied to research collaborations between the United States and its allies and partners on the one hand and additional institutions from the PRC or third countries on the other.

*Sources of Bibliographic Metadata*

Chapter 1 rests primarily on searches of the bibliographic metadata available on the China National Knowledge Infrastructure (CNKI) platform, one of the most comprehensive online aggregators of peer-reviewed academic journals, conference proceedings, theses, and dissertations in the PRC. As of mid-2020, its main China Academic Journals database offered full-text and full-image access to more than nine million articles from almost seven thousand academic journals published in the PRC since 1994.<sup>1</sup>

CNKI hosts a smaller number of international journals, as well as publication records from Elsevier, but metadata for the latter can differ in the level of detail. For instance, CNKI provides the full names of Chinese authors using Chinese characters, whereas Elsevier's ScienceDirect website may only list authors' transliterated last names and first/middle initials or a Western first name provided by the author. CNKI also usually includes the official name of associated PRC institutions in characters (some of which have misleading or truncated English translations) and PRC-based research grant or funding project names. That information is often absent from international databases such as Scopus and Elsevier. However, CNKI does not contain the entirety of the PRC's published scientific record; therefore, the corpus collected in this chapter cannot be considered an exhaustive sample of all potentially relevant articles.

The Tongfang Knowledge Network, a PRC state-owned technology group founded by Tsinghua University, develops and owns CNKI's databases. It is supported by the Ministry of Science and Technology, Ministry of Education, the General Administration of Press and Publications, and the CCP's Central Propaganda Department.

CNKI employs several websites or mirrors; [www.cnki.net](http://www.cnki.net) was primarily used for this chapter. Searches on CNKI's website were limited to publications covering scientific and engineering disciplines and

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1. "China National Knowledge Infrastructure (CNKI) Frequently Asked Questions," East View Information Services, accessed June 14, 2020, <https://www.eastview.com/resources/cnki-faq/>.

therefore excluded holdings in economics, law, history, and other social sciences.

### ***Search Process***

Searches were conducted in the following CNKI-designated journal categories:

- (A) Mathematics / Physics/ Mechanics / Astronomy
- (B) Chemistry / Metallurgy / Environment / Mine Industry
- (C) Architecture / Energy / Traffic / Electro-mechanics, etc.
- (D) Agriculture
- (E) Medicine and Public Health
- (I) Electronic Technology and Information Science

Metadata attributes (e.g., author, institution, and funding source) were searched using the “advanced search” feature available on the Chinese-language interface of CNKI’s web portal. The search criteria were:

- Articles published between January 1, 2013 and March 31, 2019 in order to spotlight recent activity.
- Chinese names of each of the Seven Sons universities and the Chinese term for “United States” (美国) in the author affiliation fields.
- Chinese names of each of the Seven Sons universities in the author affiliation field and the United States (美国) in the funding support field.<sup>2</sup>

### ***Data Conditioning***

CNKI’s web interface supports exporting search results into a spreadsheet (.xls) file. Users can manually select which attributes to export. For the purposes of Chapter 1, attributes selected for export included authors, affiliations, title, journal source, year/date of publication, and funding source (if provided).

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2. Searches and data conditioning process were repeated for each of the Seven Sons universities; hence seven distinct searches were conducted and the data was compiled separately.

The exported raw data required significant conditioning, such as parsing some of it into separate cells, and standardizing the minor English-language name variants for a given organization or unit.

Search results in CNKI also included many English-language publications from international sources, nearly all of which also appeared in Elsevier's ScienceDirect website. If additional bibliographic information was found via Elsevier that did not appear on CNKI's portal, that information was merged into the spreadsheet.

After all relevant data was collected and conditioned, the records were sorted chronologically and according to the number of articles published by each institution.

### ***Supplemental Research***

Supplemental internet research was conducted on an opportunistic subsample of authors, which provided additional detail on their affiliations, backgrounds, and sources of research funding. This detail appears in the featured case studies. The sources for that research include the institutional websites of PRC universities, research grant and funding programs, and government organizations and companies, as well as faculty profile pages, journals, and university libraries.