Iran's S&T Ecosystem

A Primer for Research Security Professionals

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For nearly five decades, relations between the Islamic Republic of Iran (IRI) and the United States (US) and its key allies have been punctuated by episodes of conflict. The US government has imposed multiple rounds of sanctions on the IRI and designated it as a foreign country of concern in the CHIPS and Science Act of 2022.[1] This advisory provides a high-level overview of key features of the IRI's science and technology (S&T) ecosystem to enhance situational awareness for the US research community and its research security professionals.

Key Findings:

- S&T researchers in the IRI collaborate extensively around the world despite international sanctions, particularly with partners in North America, Europe, and China.
- The US is the IRI's top international research partner, as measured by the annual number of coauthored publications. From 2015 to 2024, that figure increased more than 250 percent, rising from 2,051 to 5,153 publications.
- These publications include IRI-based coauthors on US government sanctions lists. Some of the research in these publications received support from US funding agencies.
- Certain IRI academic institutions are directly affiliated with military or security organizations and align closely with the S&T priorities of those organizations. They practice strict admissions and background screening, which favors students and faculty supportive of the regime.
- Civilian academics and university labs participate in military- and security-related S&T projects, often subtly embedding that work within their broader research portfolios and serving as the international face of these efforts.

- IRI military and security forces, along with their affiliated institutions, have been directly involved in coordinated cyberattacks on universities worldwide. In one notable case, hundreds of American universities were targeted between 2013 and 2017.
- The IRI's arbitrary detention of visiting researchers, as well as its use of science and technology to suppress society, including through digital surveillance and internet censorship, raises serious human rights and duty of care concerns.

▶ Introduction

This advisory aims to enhance awareness of potential research security risks posed by research collaboration with entities based in the Islamic Republic of Iran (IRI). Drawing on government policy documents, datasets, and publications collected and analyzed by NSF SECURE Analytics, the advisory provides a high-level overview of key features of the IRI's science and technology (S&T) ecosystem, including:

- The organization and management of the IRI's institutions of higher education
- The role of the IRI's military and security apparatus in S&T development
- The IRI's international research collaborations over the past ten years
- US S&T collaboration with the IRI, including with institutions affiliated with the IRI's military and security organs and with sanctioned entities
- Risks associated with the arbitrary detention of academics and S&T experts who visit the IRI

Overview of the IRI Higher Education System: Civilian and Military

The IRI's higher education system comprises some 440 civilian universities and 20 military- or security-affiliated universities.[2] Medical universities operate under the Ministry of Health and Medical Education (MHME), while general universities fall under the Ministry of Science, Research, and Technology (MSRT). In 2023, more than 3.5 million students were enrolled in IRI universities, representing approximately 3.85 percent of the country's total population.[3] The employment rate among graduates stands at only 50 percent, and limited economic opportunity serves as a significant push factor, prompting many students to consider emigration.[4]

Admissions to the IRI's civilian universities are primarily determined by performance on a national standardized entrance exam.[5]

Based on their scores, students submit a ranked list of preferred institutions to the MSRT. Top-ranking civilian universities like Sharif University of Technology and the University of Tehran are filled first by the highest scorers. Ideological, cultural, or political background does not generally impact admissions, except in the case of Baha'is, who are entirely banned from higher education regardless of academic performance, solely due to their faith.[6] There is also a quota for students from families of war veterans, of those killed in action, and of prisoners of war, but the number of eligible candidates has declined over time since its peak in the years following the Iran–Iraq War.[7]

Faculty appointments at civilian universities are subject to interviews and background checks to ensure alignment with state ideology.[8] Though faculty must appear outwardly compliant, many hold divergent private views, and full ideological control by the IRI across the civilian higher education sector remains difficult. Academic freedom is limited, and both students and professors are aware that opposing the state publicly can have serious consequences.[9]

Military- and security-affiliated universities, by contrast, require both faculty and students to undergo more stringent ideological screening. Those who choose to attend or work at these universities often do so out of genuine and close alignment with state ideology, without which it is nearly impossible to pass such strict ideological screening and background checks.[10] Unlike civilian universities, where diverse social and cultural backgrounds coexist, military- and security-affiliated universities enforce ideological homogeneity through stringent screening of individuals before admission and rigorous monitoring after admission.[11] These military- and security-affiliated institutions, such as Malek-Ashtar University of Technology (MUT), host many defense-related research and development projects. According to the MUT president, "all strategic products used on the battlefield have had their technologies developed at this university."[12]

In addition, some civilian university academics and labs also engage in scientific partnerships with the armed forces and defense industries. These collaborations span a broad range of fields, including nuclear technology, drones, missiles, and air defense systems. Such partnerships serve to subtly embed military-related projects within broader academic work. This indirect approach facilitates international collaborations when such partnerships are needed to advance defense projects. For instance, in a recent case, academics from the US, the United Kingdom (UK), and Australia collaborated with researchers at Sharif University of Technology on a drone research project with military applications.[13] Through this indirect approach, defense projects may also recruit from the larger pool of talent and expertise available at higher-ranked civilian universities, which often surpasses that of their military-affiliated counterparts in both quantity and quality.[14] The Department of Nuclear Engineering at Shahid Beheshti University presents one such example. This department was founded and staffed by senior scientists involved in

the IRI's nuclear program, several of whom were killed in 2010 covert operations allegedly attributed to Israel and during the recent Israeli attack on the IRI in June 2025.[15]

Evolution of the IRI's S&T Ecosystem

Prerevolution

Before the 1979 revolution, the Iranian higher education system was closely aligned with the US. Many universities were founded on American models or through direct academic ties: notably Aryamehr (now Sharif) University of Technology in Tehran was inspired by the Massachusetts Institute of Technology (MIT).[16] A similar alignment occurred in the security and military establishments. The shah established Iran's first central intelligence and security agency, with strong ties to the US intelligence community. He also made Iran "the largest single purchaser of US military equipment"[17] and initiated Iran's nuclear program.[18] American universities and military academies were the primary destinations for bright Iranian students pursuing graduate studies or advanced military training abroad. At its peak in 1978, 54,340 Iranian students were enrolled in US universities, likely the largest international student population in the country at the time.[19] By 2024, this number had fallen to 12,430,[20] despite the growth in both Iran's population and the increased share of international students in the US.[21]

Postrevolution

The 1979 revolution changed the direction of Iran's higher education system and S&T development. Academic relationships and exchanges with the US suffered a severe downturn immediately after the revolution, and tensions reached a peak when a group of university students stormed the US embassy in Tehran and took diplomats hostage. The crisis triggered a series of economic sanctions and an arms embargo against the IRI that would paralyze its overwhelmingly US-supplied military and security apparatus. Against this background, the Iran–Iraq War (1980–88) exposed deep vulnerabilities in Iran's defense and infrastructure while reinforcing the necessity of self-reliance. To this end, the IRI prioritized the development of indigenous scientific and industrial defense capabilities. A prime example is the IRI's missile program, initiated in the mid-1980s. The IRI's drone program emerged alongside the missile initiative, driven mainly by the same rationale: compensating for the aging and increasingly diminished capabilities of the IRI's air force.[22]

The IRI's S&T Priorities

Ayatollah Ali Khamenei, the leader of the IRI since 1989, has identified S&T development as a key source of national power. He declared in 2006, "Science equals authority; science equals power. . . . We must pursue science in its fullest sense as a form of Jihad." To reinforce this view, he cited the first imam of Shia

Islam's centuries-old statement: "Science is power. Whoever possesses it can dominate and whoever does not will be dominated."[23]

Under Khamenei's leadership, successive presidents and their administrations have sought to accelerate the IRI's S&T development, particularly in areas with defense implications. The IRI's 2021 Strategic Document on Science and Technology in the Field of Defense and Security (Strategic Document) exemplifies this dedicated funding approach for priority disciplines, technologies, and targeted R&D.[24] Although other minor laws, plans, and regulations have addressed this intersection before and after its publication, the Strategic Document remains the most comprehensive and foundational governmental document linking defense and S&T development within the IRI.

The Strategic Document emphasizes leveraging national academic, research, knowledge-based, industrial, and private sector capacities for defense and security technology development. It prioritizes safeguarding science, institutional loyalty, confidentiality, and the protection of classified scientific information. The document promotes cutting-edge defense sciences and technologies through collaboration with both national and international partners. It also aims to increase the share of military exports in the national export portfolio and strengthen scientific and technological ties with countries aligned with the IRI, such as the People's Republic of China (PRC) and Russia. The priorities and targeted fields include detectors and sensors, automated and unmanned systems, advanced military software, propulsion systems, nanotechnology, artificial intelligence, and cybersecurity. The IRI is making significant efforts and investments in these programs, regarding them as critical tools that could influence the outcomes of regional conflicts with rivals such as Israel or major power conflicts like Russia's war in Ukraine.[25] A key mechanism for actualizing this power-centric view is through state-funding allocations and support for scientific projects that contribute to this mission in both civilian- and military-linked research institutions. The IRI allocates funding for such projects through its national budget, channeling it into entities involved either directly or through their respective parent organizations.[26]

By contrast, S&T development in fields unrelated to defense and security has not kept pace. While there are minor plans and policy documents in such fields, the most comprehensive was the twenty-year plan called The Vision of the Islamic Republic of Iran for the Horizon of 1404 Solar Hijri Calendar (2025 Vision Document), adopted in 2005.[27] The 2025 Vision Document guided several areas, including S&T policy, setting a goal for the IRI to rank first in science, technology, and the economy among the countries of the Caucasus, Central Asia, and the Middle East by 2025. Due to rising tensions over the IRI's nuclear program, international sanctions, and poor state management, as of 2025, the IRI has failed to meet these objectives. This has led to the plan's near disappearance from official public discourse.

Implementation of IRI S&T Policy

The IRI's leader, Khamenei, holds significant powers as the highest-ranking political authority in the country. He oversees and makes major domestic and foreign policy decisions, including those related to S&T development. The president, elected for a four-year term, is the highest executive authority after the leader. He oversees the executive branch, implementing laws and managing national administration. Although the president has significant powers, these are limited by the leader's ultimate authority. Table 1 illustrates the powers of the leader and the president in S&T governance.

The IRI Armed Forces and Security Apparatus in S&T

The armed forces and security apparatus play integral roles in the IRI's S&T development. The IRI armed forces are divided into

TABLE 1 ▸ AUTHORITY IN IRI S&T GOVERNANCE

Leader	President
Inaugurates the president and holds the authority to remove the president with a parliamentary majority.	Appoints the minister of Science, Research, and Technology (SCSRT), who is in charge of all nonmedical civilian universities and research institutions.
Appoints all senior armed forces commanders, including those involved in military-linked S&T development or in charge of military- and security-affiliated universities.	Appoints the minister of Health and Medical Education, who is in charge of all medical civilian universities and research institutions.
Appoints all members of the Expediency Discernment Council, which resolves legislative disputes and advises the leader on policy matters, including S&T development.	Appoints the vice president for Science, Technology, and the Knowledge-Based Economy, who oversees scientific research, innovation, and high-tech growth through policy, funding, and international collaboration.
Appoints six clerical members of the Guardian Council, which must approve all legislation, including laws related to S&T development.	Chairs the Supreme Council of the Cultural Revolution (SCCR), which oversees cultural and educational policy; vets faculty, curricula, and research to ensure alignment with the IRI's Islamic and political values.
Appoints term members of the Supreme Council of the Cultural Revolution (SCCR).	Chairs the SCSRT, which sets national S&T policy, identifies research and higher education priorities, manages international cooperation, and allocates funding.

Note: The leader holds overarching authority and multiple channels of power over S&T governance, while the president oversees executive appointments and leads key national science policy councils

three main branches: the Islamic Republic of Iran Army (IRIA), which is the country's traditional military; the Police Command of the Islamic Republic of Iran (Police), the country's national police force; and the Islamic Revolutionary Guard Corps (IRGC), which protects the "Islamic Revolution and its achievements."[28] The IRGC is the most politically influential and ideologically driven of the three and is also the main driver of the IRI's missile development program.[29] It plays a central role in internal security, suppressing protests and maintaining state control over society. It is also deeply involved in various sectors of the economy such as construction, oil, telecommunications, and infrastructure development. Administratively, all three branches of the IRI armed forces are coordinated through the Ministry of Defense and Armed Forces Logistics (MODAFL). Operationally, they are overseen and coordinated by the General Staff of the Armed Forces.

The IRI security apparatus consists of two main intelligence entities: the Ministry of Intelligence (MOI), which is the country's main civilian intelligence agency, and the IRGC Intelligence Organization, which focuses on regime protection, strategic operations, and strategic influence abroad. The latter commands vast resources, conducts covert missions, and supports the IRI's regional allies and proxy groups. Both agencies gather intelligence on political dissidents, minorities, protests, and social unrest. They often operate in overlapping domains, which can sometimes undermine operational efficiency due to rivalry and weak coordination.[30]

Academic Institutions Linked to the Military and Security Apparatus

The IRI armed forces and security entities oversee a network of universities and research institutions engaged in military- and security-related higher education and research projects, as shown in figure 1.

Sanctioned Research Institutions

Among the twenty military- or security-affiliated institutions listed in figure 1, only the following three appear specifically by name on US government sanctions lists such as the Consolidated Screening List (CSL) or IRI-specific sanctions regimes.

1. Imam Hossein University (IHU) focuses on educating IRGC personnel in different fields, including engineering, military sciences, and management studies. IHU also conducts research in defense technologies, missile systems, and cyber warfare.[31]

2. Malek-Ashtar University of Technology (MUT) is affiliated with MODAFL. Its president is appointed by the Minister of Defense and is often a high-ranking military officer.[32] MUT specializes in engineering and applied sciences, offering advanced programs in fields such as aerospace, avionics, mechanical engineering, electrical engineering, and defense technologies. It supports the IRI's military-industrial capabilities by conducting research in missile systems and drones and hosts a dedicated counterintelligence center. MUT is active in international

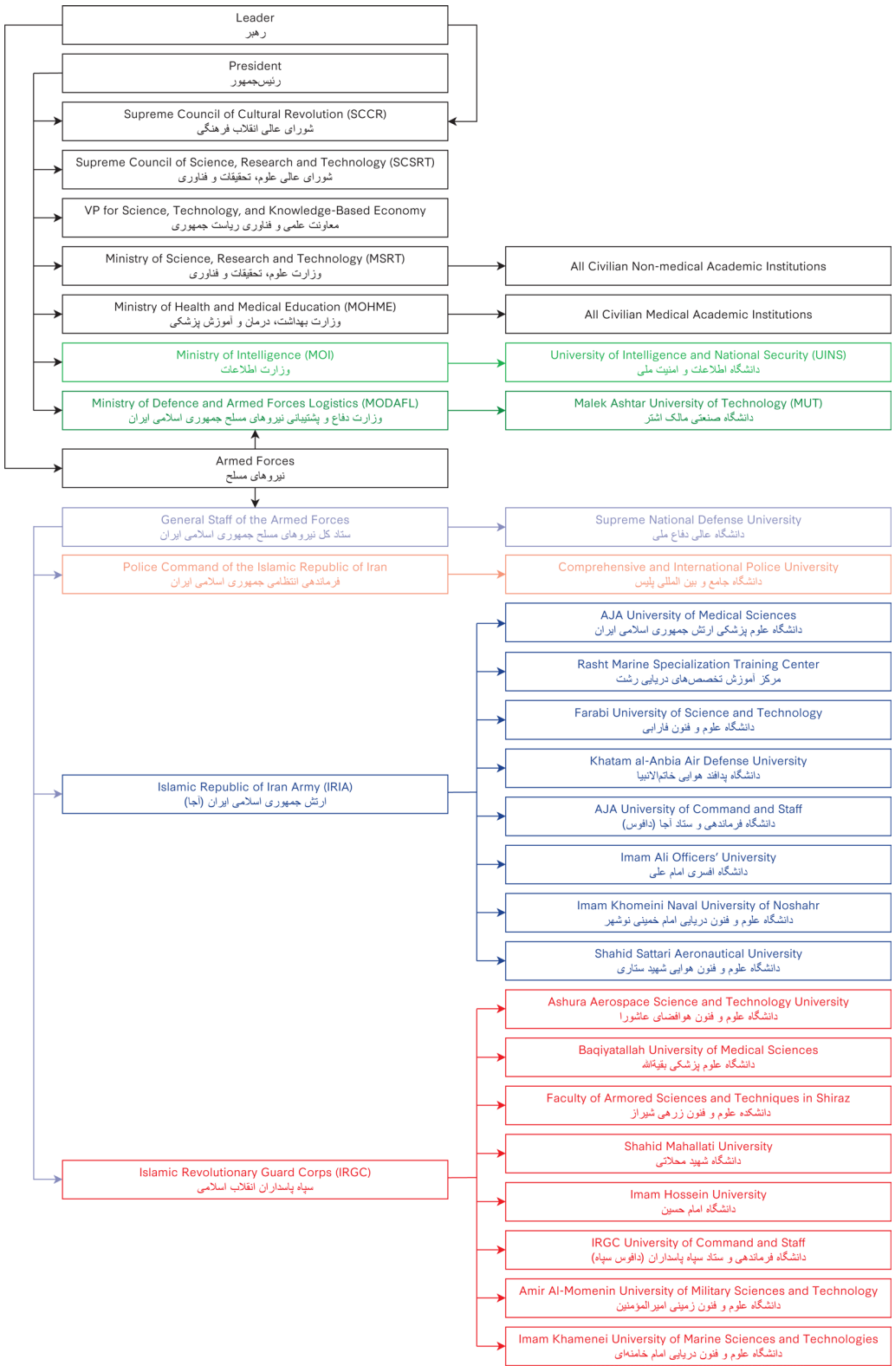

Figure 1 **IRI Military and Security Higher Education Organization Chart.** The IRI's higher education system includes twenty universities and research or training institutions affiliated with military and security organizations.

scientific partnerships, some of which may expose US institutions to second-order risk. This will be examined further below.

3. Baqiyatallah University of Medical Sciences is the IRGC's medical university. It operates hospitals and clinics and trains medical professionals for both civilian and military healthcare services. It is also involved in medical research, particularly in areas related to military medicine and defense health.[33]

4. In addition to these three military-linked institutions, the US government has sanctioned Al-Mustafa International University (MIU) by name. MIU is not officially linked to military or security institutions and is not primarily involved in S&T. It functions mainly as a religious educational institution and serves as a key instrument for the IRI to promote its ideological agenda globally through its international branches.[34] According to the US Department of the Treasury, MIU claims to have branches in over fifty countries, enabling IRI intelligence services to utilize the university's foreign students for intelligence gathering and related activities.[35] Shahid Sattari Aeronautical University, under the IRIA, is sanctioned by Canada.[36]

Nonmilitary research-performing institutions are also sanctioned, including the Iran Space Research Center (ISRC) and the Nuclear Science and Technology Research Institute (NSTRI). The ISRC is the primary institution responsible for research and development in space sciences and technologies, including the research, design, and construction of communication and remote sensing satellites, navigation and positioning systems, and space launch vehicles.[37] The NSTRI is a leading institution involved in advanced nuclear research, including reactor design, radiation technology, the nuclear fuel cycle, and radiation safety.[38]

Determining if an IRI entity is restricted or sanctioned can be challenging because the relevant designations are often issued under distinct authorities and appear on lists that may not be captured by aggregators such as the CSL. In addition, commonly used restricted-party screening tools will only display information on the searched-for entity and not necessarily its associated or governing entities. For example, a restricted-party screening may return no flags for the IRI's Supreme National Defense University because it is not sanctioned by name. However, this university is governed by the General Staff of the Armed Forces, which is sanctioned by name. The Ministry of Intelligence, the Ministry of Defense and Armed Forces Logistics, the Police Command of the IRI, the General Staff of the Armed Forces, and the Islamic Revolutionary Guard Corps are all sanctioned entities, but their subsidiary academic institutions are not, posing challenges for the due diligence workflows research security professionals conduct.

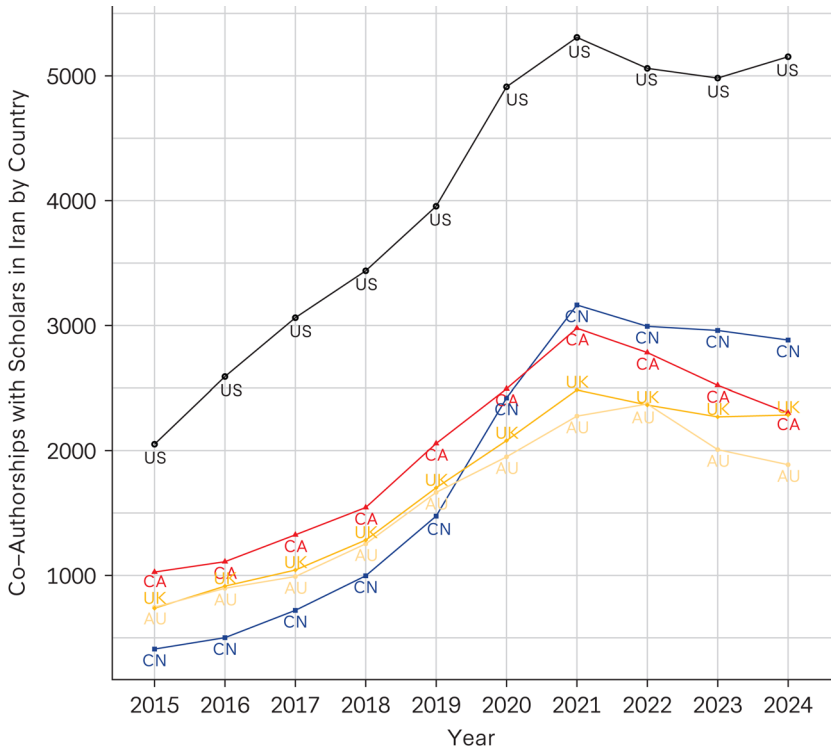

Figure 2 **Top Five Collaborating Countries with the IRI (2015–24).** During the last decade, the number of IRI–US academic collaborations doubled, and IRI–PRC partnerships also surged, reflecting significant overall growth in the IRI's international research collaborations.

Patterns in IRI International Research Collaboration

NSF SECURE Analytics' research finds that scholars in the IRI participate actively in international scientific research. In 2025, the Nature Index ranked the IRI's overall research output thirty-fourth globally and fourth in Western Asia.[39] Researchers based in the IRI collaborate most frequently with scholars based in the US, followed by scholars based in the PRC, the UK, Canada, and Australia, according to NSF SECURE Analytics' analysis of all publications in the Web of Science between 2015 and 2024 with at least one academic author affiliated with an institution in the IRI (figure 2).

Looking East

Figure 2 shows a sharp increase in IRI–PRC collaboration between 2019 and 2021. This was the highest growth rate among all countries, and it catapulted the PRC from fifth place to second place. This trend aligns with the IRI's recent "Looking East" policy, which aims to strengthen ties to the PRC and Russia.[40] In 2021, the IRI and the PRC signed a twenty-five-year Strategic Cooperation Partnership, though the details of this agreement have not been made public.[41]

The "Looking East" policy has three main rationales. First, the long-lasting confrontation between the IRI and the West, ranging from disputes over the IRI's nuclear program to regional tensions, has prompted the IRI to look for alternative partners. Second, pivoting away from the West reduces the IRI's vulnerability to economic sanctions and international pressure from a Western-dominated global financial system and institutional framework. Third, the authoritarian character of states like the PRC and Russia resonates with the IRI and takes precedence over differences that could divide them. The PRC and Russia are seen by the IRI not only as strategic allies but also as potential models for emulation.[42] In particular, the PRC presents a compelling example of a state that has achieved rapid economic and S&T development without sacrificing its authoritarian political system. Nevertheless, in the S&T domain, collaboration with the US has grown while collaboration with ostensible partners like the PRC and Russia has declined. Notably, Russia did not rank higher than 19th among countries collaborating with scholars based in the IRI.

Outside of academia, IRI–PRC cooperation manifests in critical military and security domains. For example, the PRC supplies dual-use components essential to the IRI's drone program.[43] This includes parts for the Shahed-136 drones used widely by Russia in Ukraine.[44] The PRC provides crucial raw materials for the IRI's ballistic missile program, such as sodium perchlorate and dioctyl sebacate, key chemicals required for solid-fuel missiles.[45] In the geospatial domain, the PRC shares satellite navigation and communication capabilities for military applications, including access to data from the BeiDou satellite system.[46] Chinese companies such as Tiandy Technologies export surveillance cameras and AI-based facial recognition technology used by the IRI's internal security forces. Tiandy was added to the US Department of Commerce's entity list in 2022.[47] Zhejiang Qingji Co. Ltd, a PRC company, sold centrifuge equipment for the production of propellants and combustible components to IRI firms involved in ballistic missile development. This resulted in US Treasury sanctions against Zhejiang Qingji and two of its employees.[48]

Themes in IRI–US Research Collaborations

Over the last decade, collaboration between scholars based in the US and IRI has increased overall, though, as with other nations, this increase was disrupted in 2021, perhaps related to the COVID-19 pandemic. According to the Web of Science dataset assembled by NSF SECURE Analytics, IRI–US coauthored publications credit funders from around the world, but the three most common sources are all from the US. These institutions, which each account for about 4 percent of such publications, are the US Department of Health and Human Services, the US National Institutes of Health, and the US National Science Foundation. The data also shows that the top five US academic institutions collaborating with scholars based in the IRI are the University of California System, Harvard University,

the State University System of Florida, the University of Texas System, and the University System of Ohio.

According to the Web of Science, major areas of research collaboration between IRI and American scientists since 2015 include coronavirus research, smart grid optimization, hydroclimatic modeling, nanofluid, and advanced concrete. Figure 3 presents a list of micro-topic areas, ordered by number of collaborative research publications with at least one coauthor from the US and one coauthor from the IRI.

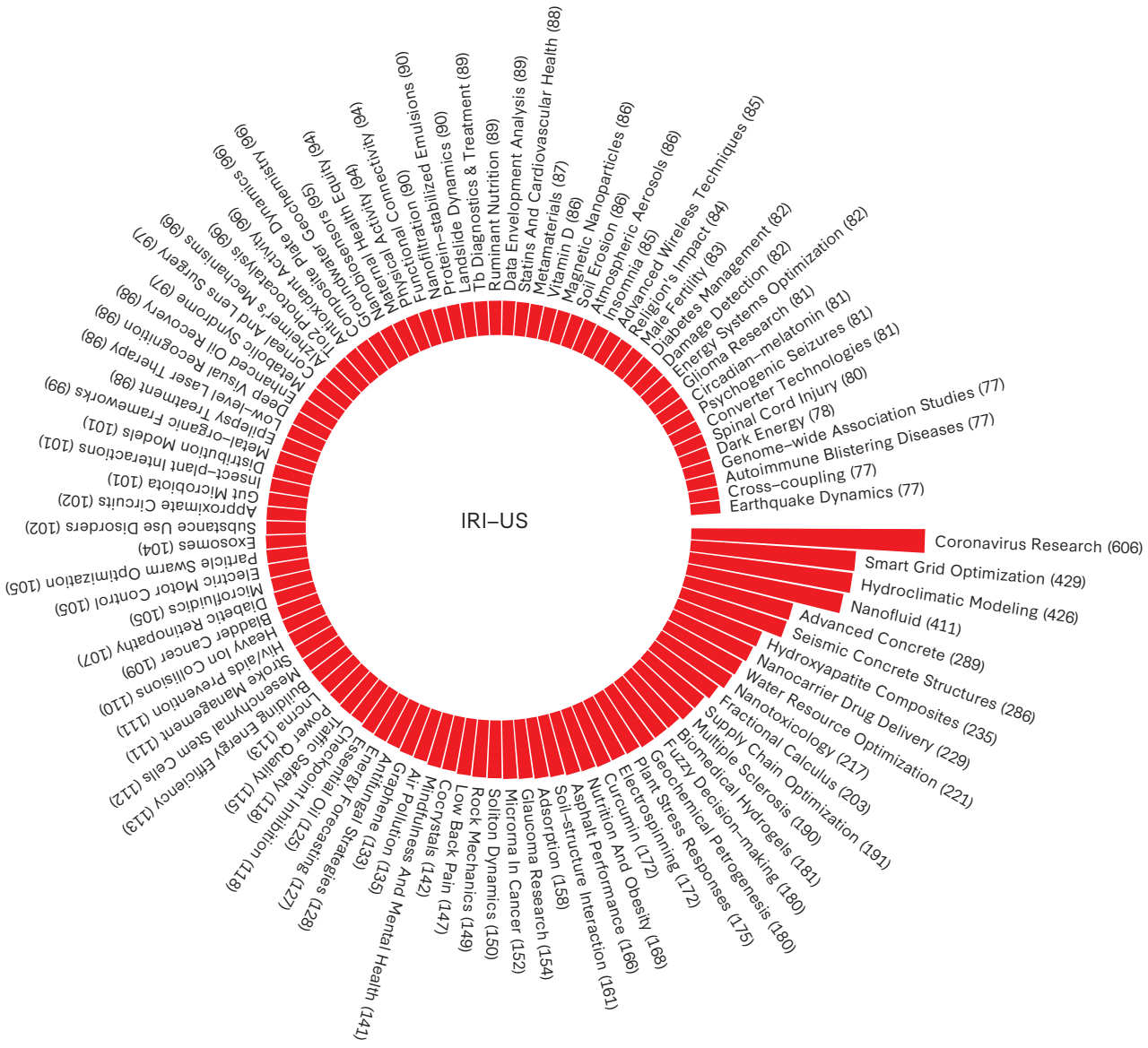

Figure 3 **Major Themes in IRI–US Scientific Collaboration (2015–2024).** The chart ranks the top 100 Web of Science micro-topics in IRI–US research collaborations based on publication count, offering insights into the distribution of IRI–US collaboration.

These topics include research that may warrant careful assessment by the research security community. Broadly speaking, research in nanotechnology, such as "Nanofluid" (411), "Nanocarrier Drug Delivery" (229), and "Nanotoxicology" (217), could be used in advanced medical treatments but also in weapons or surveillance systems.[49] In energy and environmental technologies, research in "Smart Grid Optimization" (429) could enhance energy infrastructure security but also be exploited for cyberattacks or destabilizing power grids.[50] Materials science topics such as "Advanced Concrete" (289) and "Seismic Concrete Structures" (286) could be used for both civilian infrastructure and military fortifications.[51] There are potential applications within the field of "Adaptive Control" (76) systems to UAV stability, autonomous operation, and missile guidance.[52] The field of "Metamaterials" (87) includes potential applications for UAV stealth, communications, and missile radar evasion technologies.[53] "Additive Manufacturing" (76) could be used in the fabrication of UAV and missile components.[54] Assessments of specific collaborations are beyond the scope of this advisory. Research security professionals are advised to consult scientific domain experts to support decision making about collaborations in potentially high-risk fields of research.

Collaborations Between IRI Military/Security-Affiliated Research Institutions and the US

NSF SECURE Analytics analyzed collaborations between scholars in the US and scholars based at any of the 20 military and security-affiliated institutions mentioned earlier. These collaborations account for around 1.5 percent of the total number of IRI–US research partnerships. The majority are concentrated in medical research, with the IRGC's Baqiyatallah Medical University and the Army Medical University topping the list. For example, a 2023 publication on the treatment of hormone-dependent breast cancer involved a US scholar and a team of IRI-based scientists including one from the Army's AJA University of Medical Sciences. This research received funding from the National Institutes of Health and the National Science Foundation.[55] Rigorous research security assessments should weigh the potential benefits of such collaborations alongside any risks associated with them.

Malek Ashtar University of Technology (under MODAFL) ranks third in this group, and is the top non-medical institution. Since 2015, there have been thirty-seven joint publications between an MUT-based author and a US-based author. These publications focused on two main areas: knowledge management in organizational contexts and nanotechnology to improve agricultural productivity and address food insecurity. Imam Hossein University, affiliated with the IRGC, is another academic institution from this group that has collaborated with US universities over the past decade, including work with the University of Texas in nuclear and quantum physics in 2018 and 2019.[56]

Research security risks are not limited to direct collaborations. They may also arise

when IRI researchers collaborate with third-country researchers who also work with the US. For example, one MUT scholar stands out with some 250 publications since 2015.[57] He has coauthored two papers with a scholar from Ludwig Maximilian University (LMU) of Munich, Germany, and a scholar from the Brodarski Institute in Zagreb, Croatia. All three work in the field of energetic materials, a discipline with applications in explosives. LMU is listed on both papers as the funder. The first paper introduces a method to estimate the minimum size of explosive materials needed to sustain detonation, providing valuable insight into explosion risk assessment.[58] The second paper examines how Energetic Materials Designing Bench (EMDB) software calculates essential safety and performance metrics for explosive compounds.[59] The LMU scholar in turn partners with many American researchers and institutions, including on research funded by or conducted in partnership with the Department of Defense.[60]

Further Research Security Considerations

The IRI's scientific initiatives may also have direct implications for human rights. A prominent example is the use of cybersurveillance and a comprehensive censorship regime to restrict internet access for IRI citizens. While the IRI heavily relies on countries like the PRC for support in surveilling and censoring cyberspace, IRI academics and research labs at civilian universities contribute to these projects.

For instance, an associate professor of computer engineering at Sharif University of Technology, who was once a visiting scholar at a University of California campus, was added to the US Treasury Department's Special Designated Nationals (SDN) List in 2012 due to his involvement in "the commission of serious human rights abuses against citizens of Iran or their family members."[61] His academic work and professional background reflect strong advocacy for a tightly controlled cyberspace along with significant involvement in government security projects.[62] This includes his appointment by the leader to the Supreme Council of Cyberspace, the highest governmental authority in the IRI's internet governance, responsible for overseeing internet censorship and surveillance.[63] He also collaborates internationally. One example, found via the Argus platform, is a 2018 publication on encryption, conducted in collaboration with a US-based scholar and funded by the NSF.[64] The US-based collaborator is an active recipient of NSF funding, and his most recent co-publication with this SDN-listed IRI entity dates to 2023.[65] In another case, a computer engineering professor, also from Sharif University, was added to the SDN list in 2012 due to his involvement, according to the US Department of State, in the IRI's "international procurement and nuclear proliferation operations."[66] He remains a prolific scholar with extensive international collaborations.[67] Years after his designation, NSF funding supported two collaborations he participated in, which resulted in publications in 2019 and 2021.[68]

Another human rights concern related to research security is the arbitrary detention of researchers who travel to the IRI. The IRI has a documented history of detaining foreign or dual-national researchers to exploit their technical expertise or to use them as leverage in foreign negotiations.[69] These detentions have included cases in which researchers were exchanged for IRI nationals arrested abroad on charges such as acting as agents of the IRI or attempting to evade international sanctions on behalf of the IRI or affiliated entities.

Notable cases include an IRI physicist studying in Texas, who was arrested in the IRI while visiting his family allegedly for refusing to cooperate with the state on military and nuclear projects.[70] Another case involved a Princeton graduate student who was arrested while conducting academic research in the IRI. He was later exchanged for an IRI scientist arrested in the US for violating sanctions against the IRI.[71] A more serious case involved an Iranian-Swedish physician and medical researcher who was arrested during a visit to the IRI and later sentenced to death on charges of espionage and treason.[72] He remains imprisoned, despite critical health challenges and international advocacy for his release.[73] Importantly, this issue extends beyond university-affiliated researchers. One high-profile case involved a prominent Silicon Valley software developer who was arrested by the IRGC during a family visit to the IRI and subjected to intense interrogations to coerce him into becoming an intelligence asset after his release.[74] The US has not had an operational embassy in the IRI since the 1979 revolution, which complicates efforts to provide consular assistance to citizens detained there.

The IRI conducts cyber campaigns against US institutions to obtain information related to critical S&T. In the mid-2010s, a group of hackers at the Mabna Institute coordinated a large-scale cyber intrusion campaign to steal academic data and intellectual property from hundreds of universities, private sector companies, and government organizations. This breach compromised over 100,000 accounts of professors globally, including approximately 8,000 email accounts at 144 US universities and 176 universities across 22 countries. US universities originally spent an estimated $3.4 billion to procure and access the data compromised in the attack. The attack was described as "one of the largest state-sponsored hacking campaigns ever prosecuted by the Department of Justice."[75] In March 2018, the DOJ indicted nine Mabna hackers for carrying out these attacks on behalf of the IRGC. The Mabna Institute currently appears on the Department of Defense's Section 1286 restricted party list. In a more recent case, the DOJ indicted four individuals, including one affiliated with the IRGC, for targeting the US Departments of the Treasury and State, defense contractors, and two private companies in New York in 2024.[76]

Conclusion

The IRI's emphasis on S&T development is deeply intertwined with the nation's history of conflict and its need to secure survival in a highly volatile geopolitical environment. The 1979 revolution decoupled Iran from the US, exposing the country's vulnerabilities due to its dependence on American technology and military support. The Iran–Iraq War in the 1980s underscored these risks, prompting the IRI to prioritize military self-sufficiency, particularly in nuclear, missile, and drone technologies. To strengthen self-reliance, the IRI prioritized S&T development for military and security goals. The IRI research ecosystem includes institutions directly affiliated with military or security organizations. These factors pose research security-related challenges for American academic institutions. Addressing these challenges requires sophisticated data analytics and an understanding of the science, geopolitical context, and the human dimensions of the IRI's scientific community. NSF SECURE Analytics will follow the dynamics of the IRI's S&T ecosystem and keep the US research community informed.

APPENDIX 1: KEY TERMINOLOGY

- **Ministry of Science, Research, and Technology (MSRT**, وزارت علوم، تحقیقات و فناوری**)** This ministry oversees and regulates all aspects of civilian universities and research institutions. It is responsible for appointing key academic and administrative officials, such as university deans. The ministry manages budget allocations to civilian universities and ensures adequate financial resources for academic programs, research, infrastructure, and operations. The ministry also plays a central role in shaping university curricula, setting academic standards, and ensuring that educational programs align with national priorities.

- **Ministry of Health and Medical Education (MHME**, وزارت بهداشت، درمان و آموزش پزشکی**)** This ministry has functions similar to those of the MSRT, but it focuses on medical universities and research centers. It is responsible for managing civilian medical universities and research institutions and overseeing education in medical sciences and the healthcare system.

- **Supreme Council of the Cultural Revolution (SCCR**, شورای عالی انقلاب فرهنگی**)** The council is a governing body responsible for shaping policies and procedures that regulate the entire IRI's research and higher education ecosystem. This includes establishing general principles and regulations for developing scientific, research, and cultural relations with foreign countries. The council also defines and enforces requirements for academic appointments and curricula. All candidates for university presidency roles must receive approval from the SCCR. Council members fall into two categories: (a) ex-officio members and (b) five-year-term members appointed by the leader.

- **Supreme Council of Science, Research, and Technology (SCSRT**, شورای عالی علوم، تحقیقات و فناوری**)** The council is an advisory and decision-making body responsible for setting national policies and strategic directions related to science, research, and technology. Its roles include identifying priority research areas, developing frameworks for S&T education, and managing international scientific cooperation. The council also determines funding priorities for S&T and coordinates efforts among various ministries, academic institutions, and research centers involved in these fields. SCSRT is chaired by the president and includes members such as the MSRT, the MHME, the minister of industry, and other senior government officials, as well as prominent scientists and experts from diverse fields.

- **Vice President for Science, Technology, and the Knowledge-Based Economy (**معاونت علمی، فناوری و اقتصاد دانش‌بنیان**)** The VP is responsible for advancing scientific research and technological innovation. The VP develops policies to promote high-tech industries, supports startups, and fosters the growth of knowledge-based companies. The VP also oversees funding for R&D projects and facilitates international scientific collaboration.

- **Strategic Document on Science and Technology in the Field of Defense and Security (Strategic Document**, سند جامع علم و فناوری در حوزه دفاعی و امنیتی جمهوری اسلامی ایران**)** The 2021 strategic document is the IRI's most comprehensive, foundational government plan outlining long-term goals, priorities, and frameworks for advancing defense technologies and national security through S&T innovation.

- **The Vision of the Islamic Republic of Iran for the Horizon of 1404 Solar Hijri Calendar (2025 Vision Document**, چشم‌انداز جمهوری اسلامی ایران در افق ۱۴۰۴ هجری شمسی**)** The 2025 Vision document was a strategic government plan to position the IRI as a first-rank country in economy and S&T among Middle Eastern, Central Asian, and Caucasus nations by the target year of 2025.

APPENDIX 2: NETWORK OF MILITARY AND SECURITY HIGHER EDUCATION

The **General Staff of the Armed Forces (GSAF**, ستاد کل نیروهای مسلح**)** coordinates all branches of the IRI's armed forces at the military operational level, overseeing strategy, planning, and joint operations to ensure effective military readiness and unified command.

The **Supreme National Defense University (SNDU**, دانشگاه عالی دفاع ملی**)**, affiliated with GSAF, is a military institution focused on training strategic commanders, conducting research and analysis, advising armed forces leadership, producing key strategic documents, and supporting allied nations through academic diplomacy and educational cooperation.

The **Ministry of Defense and Armed Forces Logistics (MODAFL**, وزارت دفاع و پشتیبانی نیروهای مسلح**)** oversees all branches of the IRI"s armed forces at the administrative level, managing logistics, procurement, and coordination to support military operations and ensure defense readiness.

Malek-Ashtar University of Technology (MUT, دانشگاه صنعتی مالک اشتر**)**, affiliated with MODAFL, focuses on advanced engineering and defense technologies. It supports the IRI's military-industrial development, especially in missiles and drones. Led by defense officials, it has a counterintelligence center and close ties to military institutions.

The **Islamic Republic of Iran Army (IRIA**, ارتش جمهوری اسلامی ایران**)** is the country's conventional military force. Its primary responsibilities are to defend the IRI's sovereignty, safeguard its borders, and protect the nation from external threats. It is largely focused on traditional military functions such as warfare and defense planning.

AJA University of Medical Sciences (دانشگاه علوم پزشکی آجا) is a medical university affiliated with the IRIA. It operates hospitals and healthcare facilities and offers advanced education and training in medical and healthcare fields with both civilian and military applications.

AJA University of Command and Staff (دانشگاه فرماندهی و ستاد آجا) is a prestigious military academy affiliated with the army. It prepares officers for senior roles in the army and provides advanced education and training for army officers, with a focus on leadership, strategic studies, and operational command.

Imam Ali Officers' University (دانشگاه افسری امام علی), affiliated with IRIA Ground Forces, is the oldest military higher education institution in the country. It focuses on training officers in army leadership, strategy, and defense sciences.

Rasht Marine Specialization Training Center (مرکز آموزش تخصص‌های دریایی رشت), affiliated with IRIA Navy, is focused on specialized education for naval and maritime operations, marine engineering, navy aviation and telecommunications.

Imam Khomeini Naval University of Noshahr (دانشگاه علوم و فنون دریایی امام خمینی) affiliated with the IRIA Navy, is focused on naval education and training in maritime warfare, offering programs in naval engineering, maritime strategy, and military leadership and applied sciences.

Farabi University of Science and Technology (دانشگاه علوم و فنون فارابی) is a higher education institution affiliated with the IRIA Intelligence Organization. It collaborates with the Ministry of Intelligence, focusing on defense intelligence and counterintelligence.

Shahid Sattari Aeronautical University (دانشگاه علوم و فنون هوایی شهید ستاری), affiliated with the IRIA Air Force, trains air force pilots; flight engineers; and experts in aerospace engineering, electrical engineering, mechanical engineering, and drone technology. It also prepares officers for leadership roles in the air force.

Khatam al-Anbia Air Defense University (دانشگاه پدافند هوایی خاتم‌الانبیا) is affiliated with the IRIA Air Defense Force. It focuses on providing advanced education and training in air defense systems, missile technology, radar operations, and aerospace engineering.

The **Islamic Revolutionary Guard Corps (IRGC**, سپاه پاسداران انقلاب اسلامی**)**, the IRI's second major armed force, is ideologically driven and politically influential. Tasked with protecting the Islamic Revolution, it dominates internal security, suppresses dissent, and holds vast economic power across construction, oil, telecommunications, and infrastructure sectors.

IRGC University of Command and Staff (دانشگاه فرماندهی و ستاد سپاه پاسداران انقلاب اسلامی) is a military academy that specializes in training high-ranking military officers, providing advanced education in military strategy, leadership, and command.

Ashura Aerospace Science and Technology University (دانشگاه علوم و فنون هوافضای عاشورا) is affiliated with the IRGC Aerospace Force. It specializes in aerospace engineering and missile technology. It also trains pilots and officers for air traffic control, flight services, missile operations, and air defense operations.

Imam Hossein University (IHU, دانشگاه امام حسین**)** focuses on educating IRGC personnel in different fields, including engineering, military sciences, and management studies. IHU also conducts research in defense technologies, missile systems, and cyber warfare.

Baqiyatallah University of Medical Sciences (دانشگاه علوم پزشکی بقیةالله) is the IRGC's medical university. It operates hospitals and clinics and trains medical professionals for both civilian and military healthcare services. It is also involved in medical research, particularly in areas related to military medicine and defense health.

Amir Al-Momenin University of Army Sciences and Technology (دانشگاه علوم و فنون زمینی امیرالمؤمنین) is one of the biggest IRGC staff military colleges for ground forces officers. It focuses on advanced education in military S&T and engineering for ground forces.

Faculty of Armored Sciences and Techniques in Shiraz (دانشکده علوم و فنون زرهی شیراز) is affiliated with the IRGC Ground Forces and specializes in training officers and personnel for armored and mechanized warfare.

Imam Khamenei University of Marine Sciences and Technologies (دانشگاه علوم و فنون دریایی امام خامنه‌ای) is the military college for training officers for the IRGC's Navy. It offers advanced education in engineering, technology, and military sciences, with a focus on developing technical expertise in marine, missiles, and naval aviation.

Shahid Mahallati University (دانشگاه شهید محلاتی) is the training center for the IRGC's ideological and political instructors.

The **Police Command of the Islamic Republic of Iran (Police**, فرماندهی انتظامی جمهوری اسلامی ایران**)** is the IRI's national police, tasked with maintaining public order; enforcing laws; and handling crime prevention, arrests, and investigations. The Police also manage protests and unrest, serving as the regime's first line of internal control.

Comprehensive and International Police University (دانشگاه جامع و بین المللی پلیس) is affiliated with the IRI Police. It provides higher education and training in law enforcement, criminology, security studies, intelligence gathering, and cybercrime. It trains the personnel and prepares officers for leadership roles in the Police.

The IRI's **Ministry of Intelligence (MOI**, وزارت اطلاعات**)** is the country's main civilian intelligence agency, responsible for domestic surveillance, counterintelligence, and foreign espionage.

University of Intelligence and National Security (UINS, دانشگاه اطلاعات و امنیت ملی**)**, affiliated with the MOI, trains officers in intelligence gathering, analysis, counterintelligence, and security operations through specialized programs and courses.

APPENDIX 3: METHODOLOGY AND DATA COLLECTION

This study employs a hybrid methodology that combines both qualitative and quantitative data. For the qualitative component, the analysis primarily draws on official government policies and documents from both the IRI and the US. For the IRI, key documents originally in Persian were carefully selected, vetted, and translated by the NSF SECURE Analytics team. For the quantitative component, the team compiled a comprehensive dataset of scholarly publications from the Web of Science in August 2025. The team extracted metadata such as the publication year and author affiliation in order to illustrate patterns of international collaboration over time. In addition, the team analyzed the research topics associated with these publications to identify the major thematic areas with the highest number of publications between 2015 and 2024. This analysis used the Web of Science citation topic classification system, which includes a hierarchical structure consisting of 10 macro-topics, 326 meso-topics, and 2,444 micro-topics.[77] The team's discussion of potentially high-risk fields is based on an analysis of micro-topics. The team decided to remove approximately 1,100 publications related to micro-topic 5.9.19 (Beyond Standard Model) because these publications are the result of the Compact Muon Solenoid (CMS) Collaboration at the European Organization for Nuclear Research (CERN).[78] These publications typically have a very large number of coauthors, making it difficult to identify the significance of the IRI's contribution with confidence.

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