

QIR

Quantum
Index Report
2025

MIT INITIATIVE ON THE DIGITAL ECONOMY

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▶ Interactive website and public data

The Quantum Index Report 2025 is accompanied with interactive tools available on our website (qir.mit.edu) and we share our raw data with the community available to download from our website (qir.mit.edu/data).

In memory of Shawneric Hachey, whose unique talent and dedication shaped the way this project is presented today.



Center for Quantum Networks
A National Science Foundation Engineering Research Center



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2 | Academic Research

Academic publications serve as an early indicator of scientific progress, typically preceding commercial applications in Quantum Technologies. Citation patterns and collaborations in journal papers can highlight research quality, interdisciplinary connections, and international partnerships shaping the field. Through comprehensive analysis of publication metrics, researchers can identify emerging trends, assess knowledge transfer mechanisms, and understand the evolution of quantum research ecosystems globally. This chapter presents data on academic publications on quantum computing and quantum communications based on research by the ASPI.¹

Quantitative assessment of research output provides valuable insights into national capabilities in quantum technologies. Total publication counts offer a broad perspective on research activity levels across nations, reflecting the scale of investment in quantum research infrastructure and the size of research communities. When combined with H-index² measurements and citation data³, which account for both productivity and citation impact, these metrics reveal the depth and influence of research programs. This dual perspective helps distinguish between quantity and quality of research output, allowing for a nuanced understanding of each nation's contribution to the rapidly developing quantum knowledge base.

2.1 | Quantum computing

2.1.1. Rankings by published research

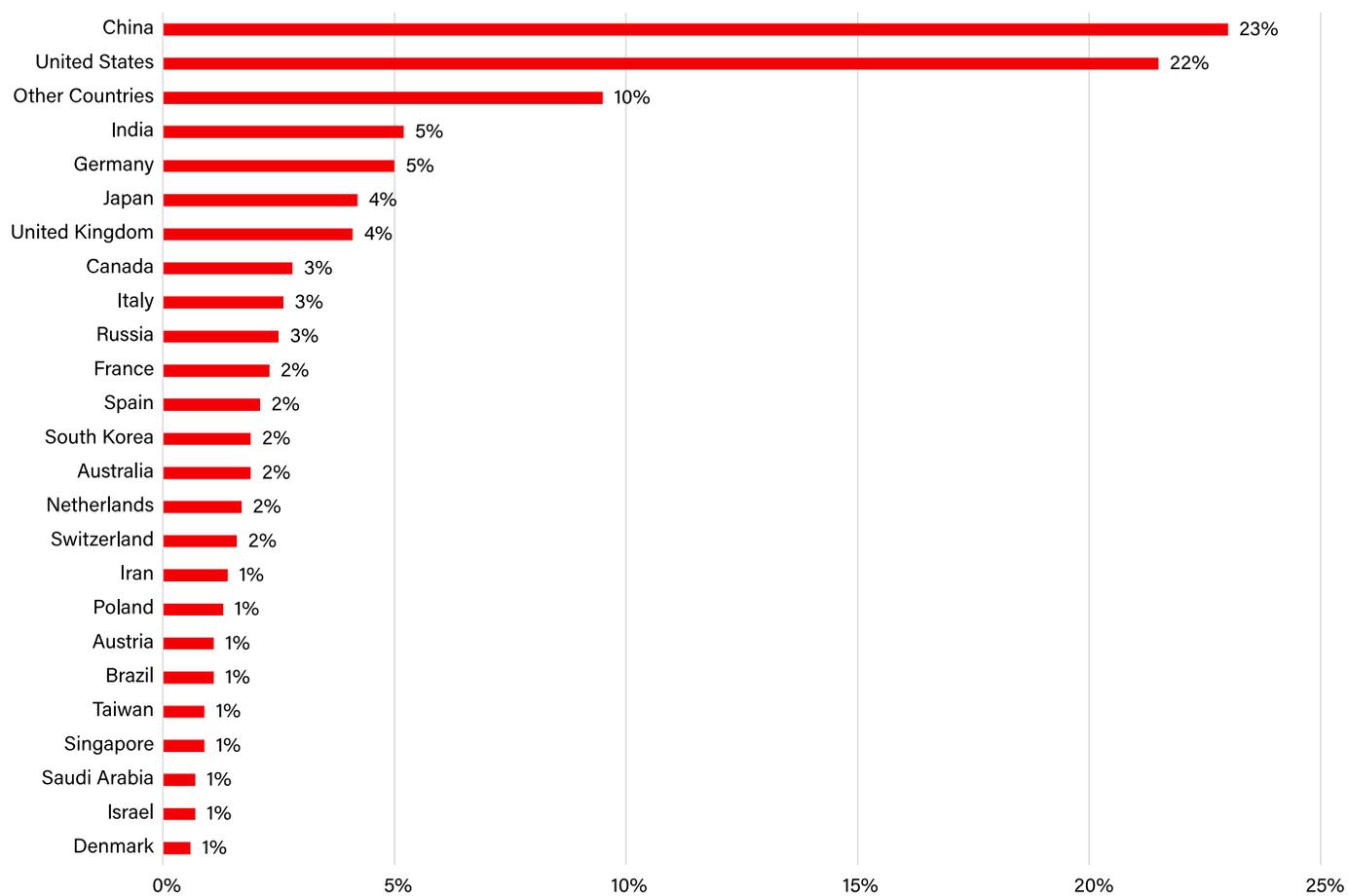
- ▶ The US and China represent nearly half of all academic publications in quantum computing. The European Union accounts for 22% of global output. India, Japan and the United Kingdom produce a large volume of research but significantly trail the two global leaders.

The global landscape of quantum computing publications reveals a highly concentrated distribution pattern, with China and the United States collectively accounting for nearly half of all published research. China leads with 23% of publications, followed closely by the US at 22%, while India emerges as the third major contributor with 5%. This top-heavy distribution creates a clear tier structure in global quantum computing research output.

The middle tier of contributors demonstrates significant diversity, with Germany and Japan each contributing 5% and 4% respectively, followed by the United Kingdom at 4%. Canada, Italy, and Russia each contribute 3% of global publications, forming a secondary cluster of substantial contributors. This middle tier represents a crucial segment of global quantum computing research, bridging the gap between the dominant players and smaller contributors.

The lower tier of the distribution reveals a broad base of international participation, with several countries each contributing 2% of global publications, including France, Spain, Australia, South Korea, the Netherlands, and Switzerland, showing widespread engagement across multiple regions staying active in quantum computing research. The remaining countries, including Iran, Poland, Brazil, Austria, Singapore, Taiwan, Israel, Saudi Arabia, and Denmark, each contribute 1%, forming a diverse foundation of global participation in this field.

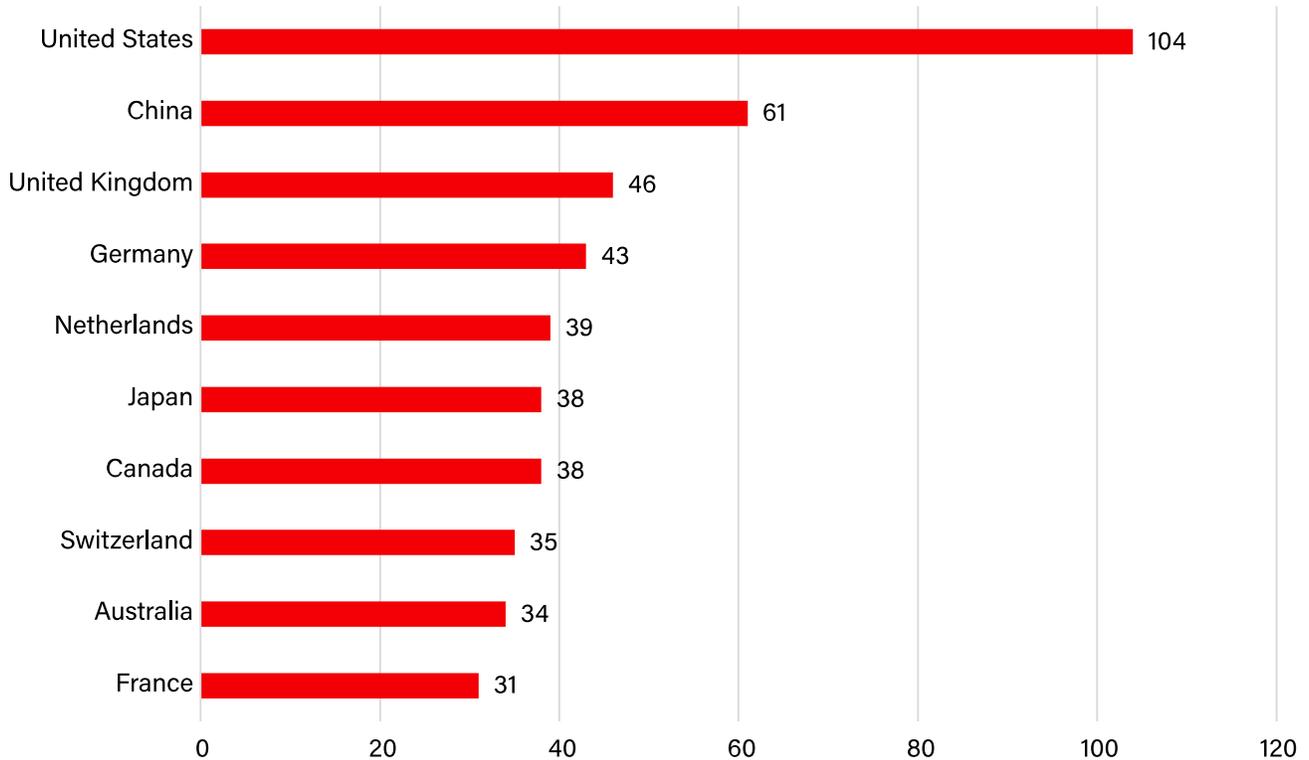
National share of quantum computing published research, 2019-2023



2.1.2. Rankings by H-index

- ▶ US quantum computing research quality is ranked highest in the world, significantly ahead of other countries. China ranks second with an H-index of 61, followed by the United Kingdom with 46.

National quantum computing published research ranked by H-index, 2019-2023



In the landscape of quantum computing research quality measured by H-index, the United States stands as the clear leader with an H-index of 104, demonstrating exceptional research productivity and citation influence. This score reinforces why American institutions are at the forefront of quantum computing advancement, significantly outperforming all other nations.

Following the United States, China emerges in second position with an H-index of 61, representing a substantial research presence. The top two nations highlight the current state of global competition in quantum computing research.

The United Kingdom rounds out the top three positions with an H-index of 46, demonstrating Europe's significant contribution to quantum computing research excellence.

The middle tier of the distribution reveals intense activity among nations. Germany and the Netherlands lead this group with H-index scores of 43 and 39 respectively, followed closely by Canada and Japan, which tie at 38. Switzerland maintains a strong research presence with an H-index of 35, and Australia contributes meaningfully at 34. France completes this tier with an H-index of 31, demonstrating impressive research productivity despite being slightly lower than its European counterparts.

2.1.3. Rankings by most highly cited papers

- ▶ Among the top 10% of the most highly cited papers in quantum computing, the United States has the largest proportion of publications with 34%. China follows with the second highest proportion, 16%. The European Union accounts for an estimated 17% of the global total.

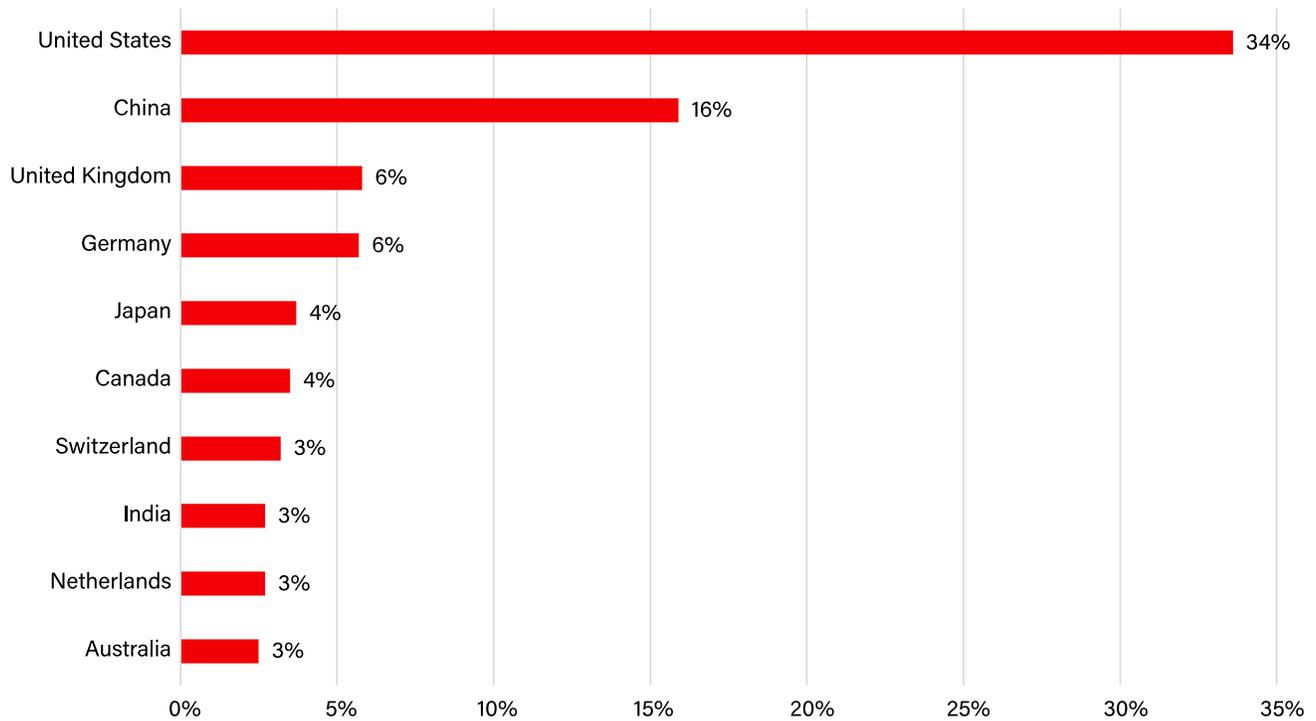
By analyzing the country of origin of the top 10% most highly cited quantum computing papers, we gain insight into where the field's most influential ideas are emerging from.

The United States leads this group with 34% of the most highly cited quantum computing publications, demonstrating exceptional research impact and influence.

China emerges as a strong second with 16% of highly cited publications, reinforcing its position as the primary challenger to US research leadership. This position is noteworthy as it represents a substantial gap between China and the next tier of countries. The United Kingdom and Germany tie for third place with 6% each, illustrating Europe's strong presence in high-impact quantum computing research.

The middle tier of the distribution shows interesting patterns of research excellence. Japan and Canada each contribute 4% of highly cited publications, while Switzerland, the Netherlands, India, and Australia form a closely grouped cluster at 3% each. This relatively small spread among these countries suggests a competitive landscape where institutions are achieving similar levels of citation impact despite their geographical and institutional differences.

National share of top 10% most highly cited quantum computing publications, 2019-2023



This distribution of highly cited publications reveals several key characteristics of quantum computing research excellence. First, it shows a clear hierarchical structure with the United States holding a dominant position, followed by China in a secondary tier, and then a cluster of countries achieving similar levels of impact. Second, it demonstrates that research excellence isn't solely determined by absolute size or resources, as evidenced by smaller nations such as the Netherlands maintaining a strong position. Finally, it highlights the internationally diverse nature of high-impact quantum computing research, with representation from North America, Europe, and Asia-Pacific regions. This suggests a globalized research ecosystem, albeit one with a concentration of leadership from developed nations.

2.1.4. Rankings overall

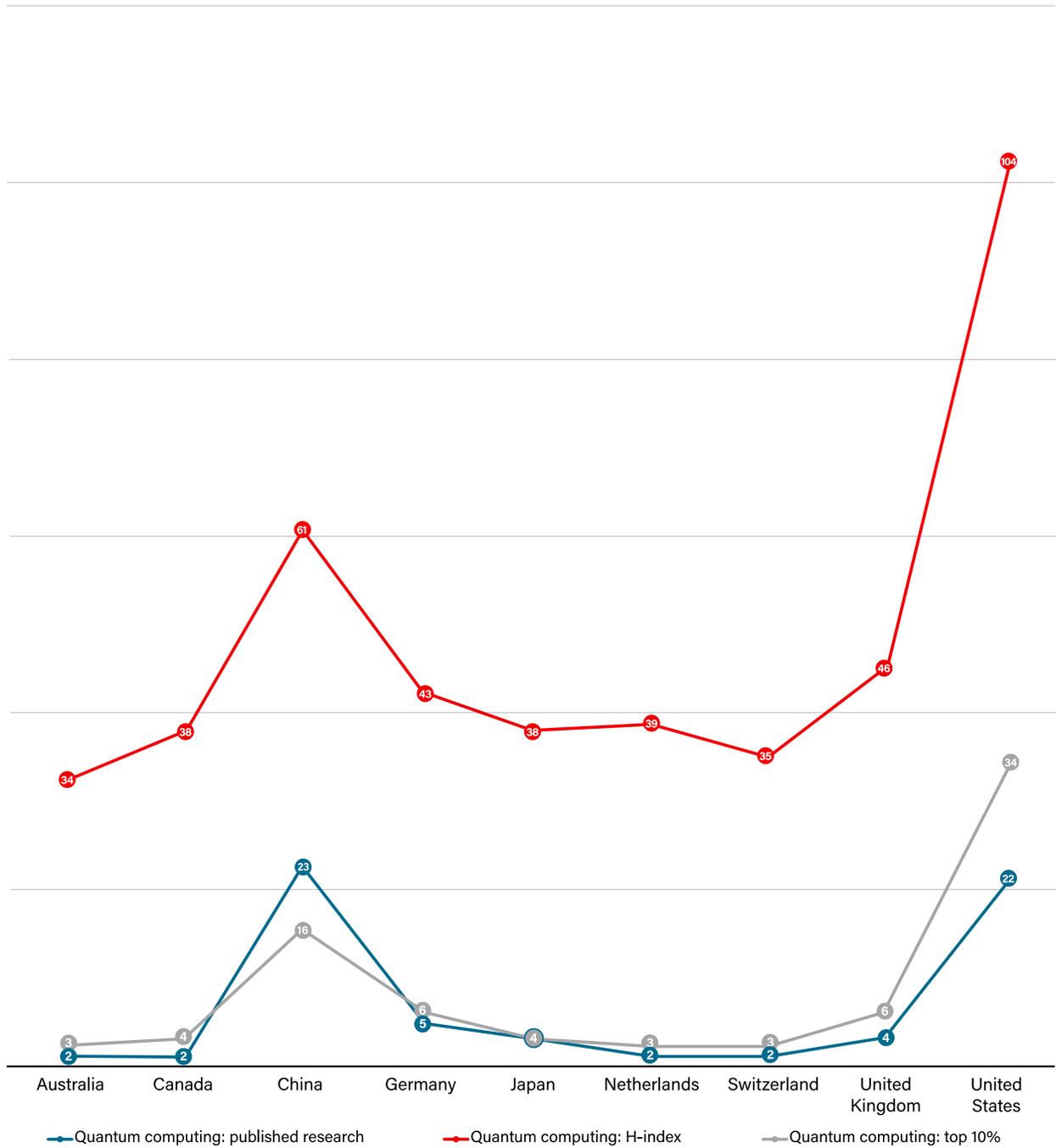
The United States demonstrates remarkable consistency across all three metrics, placed among leaders in total publications (22%), and in top position in the H-index (104), and highly cited publications (34%). This strong leadership position suggests not only high research productivity but also exceptional research quality and impact.

China presents an intriguing case of varying performance across metrics. While leading in total publications (23%), it ranks second in highly cited publications (16%) and drops to second place in H-index (61). This pattern suggests that while Chinese institutions produce the highest volume of research, they haven't yet achieved the same level of citation impact as US institutions.

European nations show distinct patterns across the metrics. The United Kingdom, for instance, ranks third in H-index (46) but wasn't among the top contributors in total publications, indicating high-quality research despite lower publication volumes. Conversely, Germany ranked fourth in H-index (43) while maintaining fifth place in publication count (5%), showing strong consistency across both metrics. The Netherlands demonstrates exceptional efficiency, ranking fifth in H-index (39) despite being absent from the top publication counts, suggesting highly impactful research despite moderate publication volume.

Japan offers another compelling case study, appearing in the middle tier of both rankings (tied for sixth in H-index at 38 and seventh in publications at 4%). This consistency suggests a balanced approach to research quality and quantity. Canada maintains similar positioning in both metrics (seventh in H-index at 38 and eighth in publications at 3%), demonstrating steady performance across both dimensions.

Quantum computing research rankings overview



2.2 | Quantum communications

2.2.1. Rankings by published research

- ▶ China publishes over one-third of all quantum communications research whereas the United States follows as a distant second. The European Union accounts for 21% of the global total publications. UK, Germany and India are the only others generating 5% of the global output.

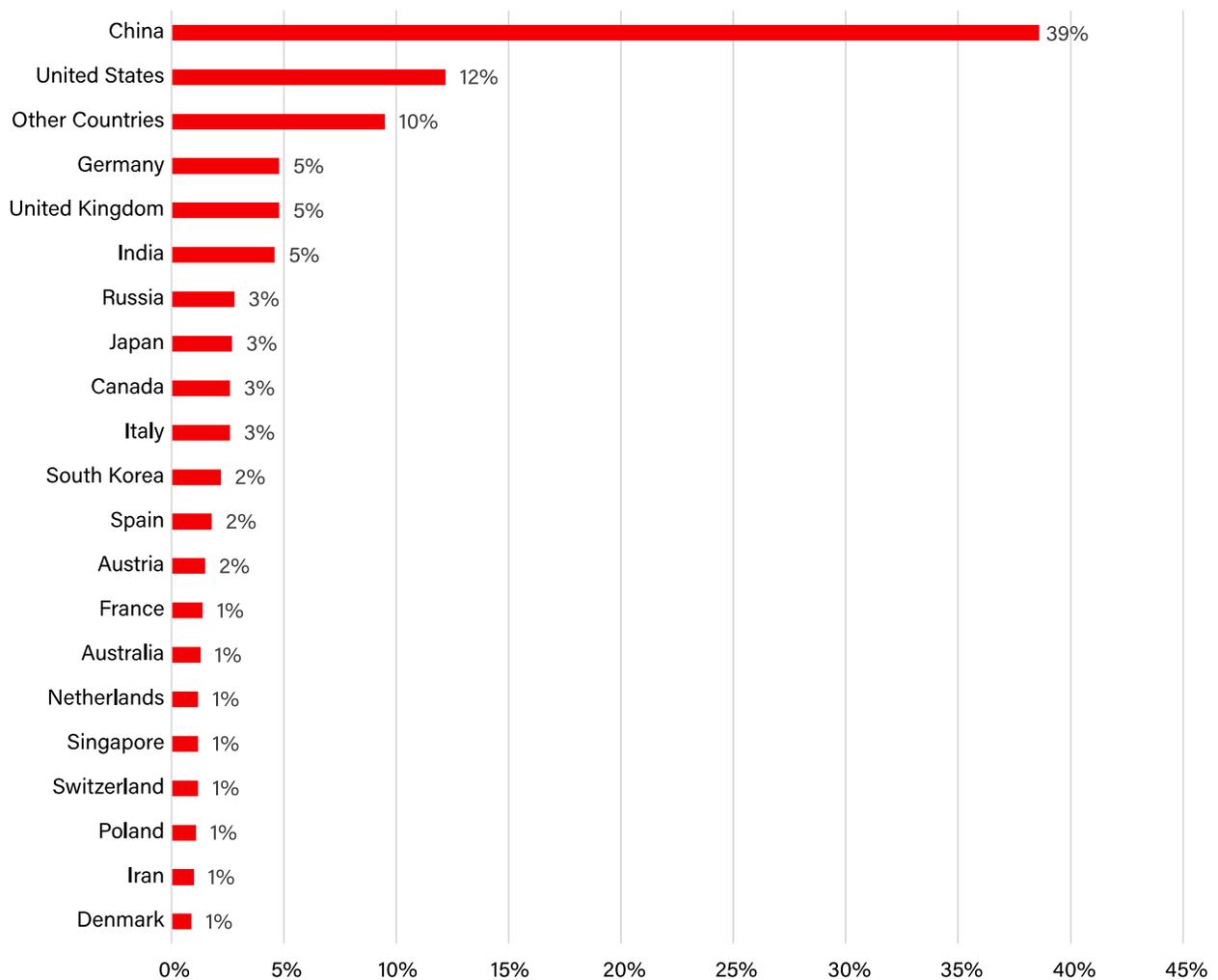
China has emerged as the dominant force in quantum communications research output with an impressive 39% of total publications. This substantial lead is particularly notable given that quantum communications represents a specialized area within quantum technology, suggesting deliberate and targeted research efforts and significant institutional capacity. This research effort has likely aided China's success in deploying space-based quantum communications that utilize satellites and long distance QKD networks.

The United States follows as a distant second with 12% of publications, while the United Kingdom, Germany, and India form a closely grouped cluster, each

contributing 5% of total publications, demonstrating balanced research output across these major scientific powers.

The middle tier of the distribution shows interesting patterns of research engagement. Russia, Japan, Italy, and Canada each contribute 3% of publications, forming a secondary cluster of substantial contributors. South Korea, Spain, and Austria follow with 2% each, while France, Australia, Switzerland, Singapore, the Netherlands, Poland, Iran, and Denmark complete the distribution with 1% each. This broad international participation suggests a vibrant global research ecosystem in quantum communications, though with clear tiers of research intensity.

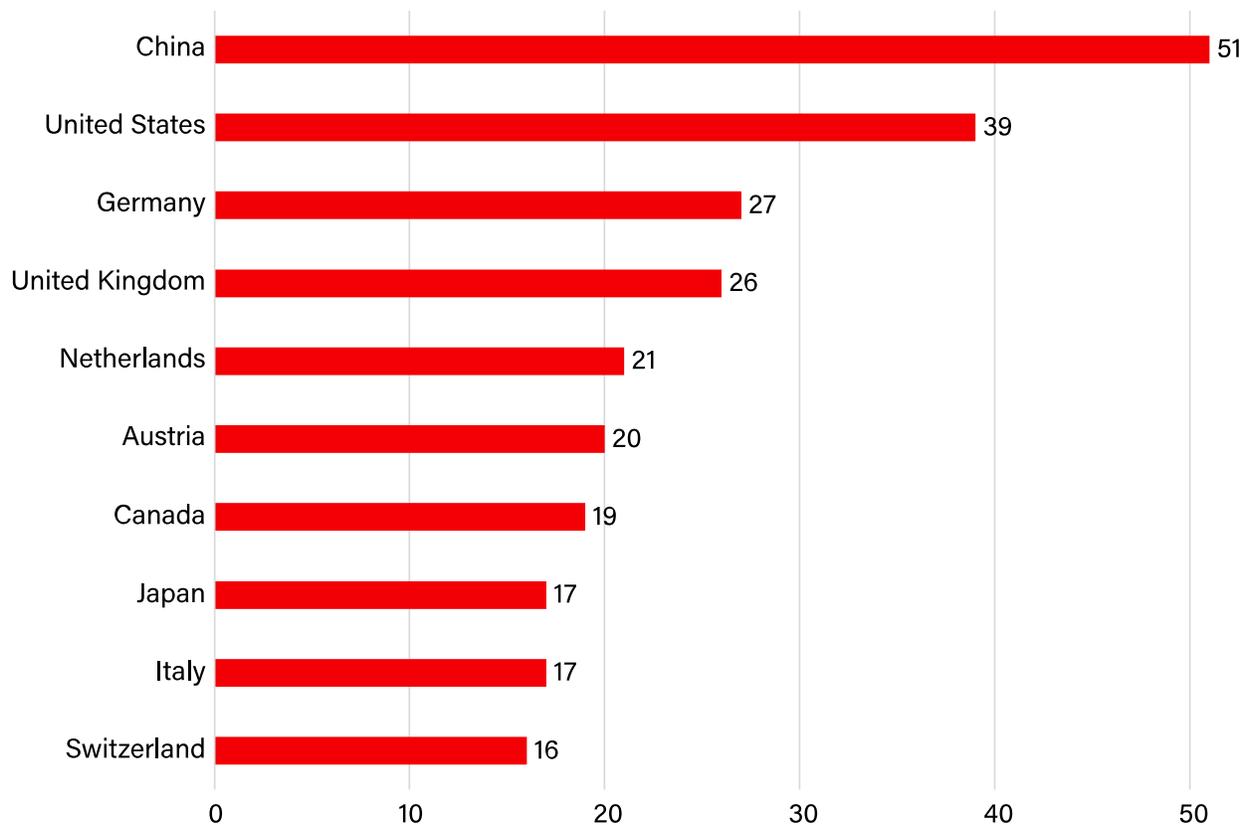
National share of quantum communications published research, 2019-2023



2.2.2. Rankings by H-index

- ▶ In quantum communications, China leads in terms of research quality with an H-index of 51, ahead of the US which takes the second place with 39. Germany and the United Kingdom follow with H-index of 27 and 26, respectively.

National quantum communications published research ranked by H-index, 2019-2023



China stands as the leader in the field, with an H-index of 51, demonstrating exceptional research productivity and citation influence. This score places Chinese institutions such as the University of Science and Technology (USTC) firmly at the forefront of quantum communications advancement, significantly outperforming all other nations.

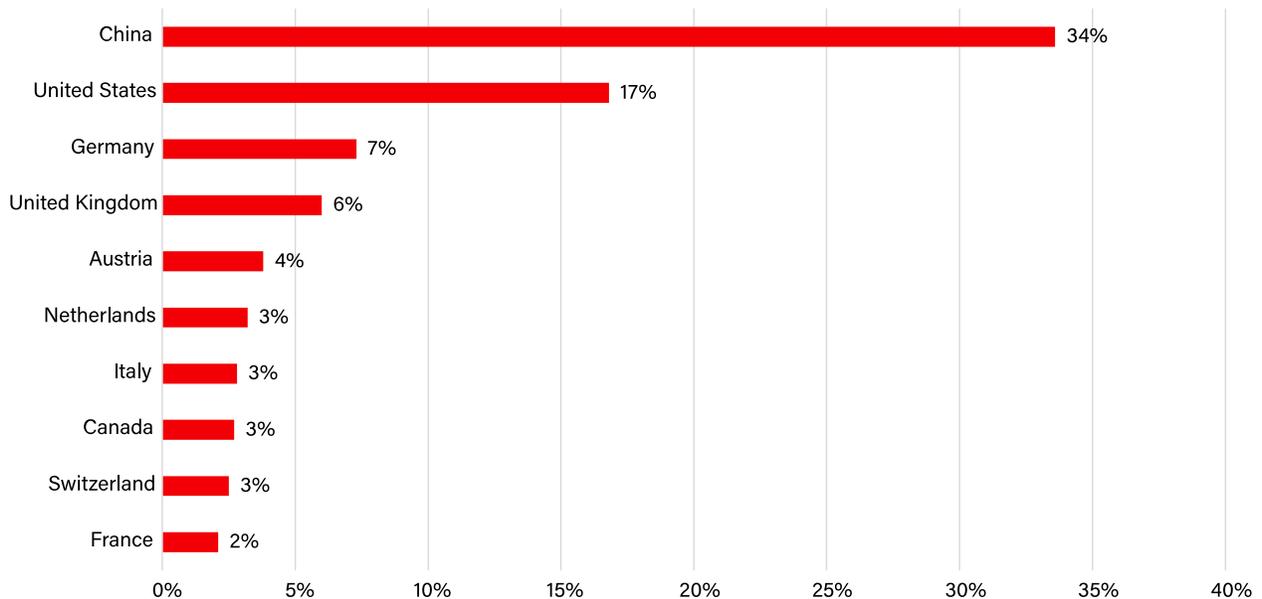
Following China's lead, the United States emerges as a strong second with an H-index of 39, representing a substantial research presence despite being notably lower than China's figure. The top two nations highlight the current state of global competition in quantum computing research.

The middle tier of the distribution reveals intense competition among European nations and Japan. Germany leads this group with an H-index of 27, followed closely by the United Kingdom at 26. The Netherlands maintains a strong research presence with an H-index of 21, while Austria contributes meaningfully at 20. Canada demonstrates an H-index of 19, while Italy and Japan tie at 17, suggesting balanced research ecosystems outside the leading powers. Switzerland completes this tier with an H-index of 16, demonstrating consistent research productivity despite being slightly lower than European counterparts.

2.2.3. Rankings by most highly cited papers

- ▶ China has a third of the top 10% of the most highly cited quantum communications publications. The United States follows with 17%. The combined European nations account for 28% of the global total.

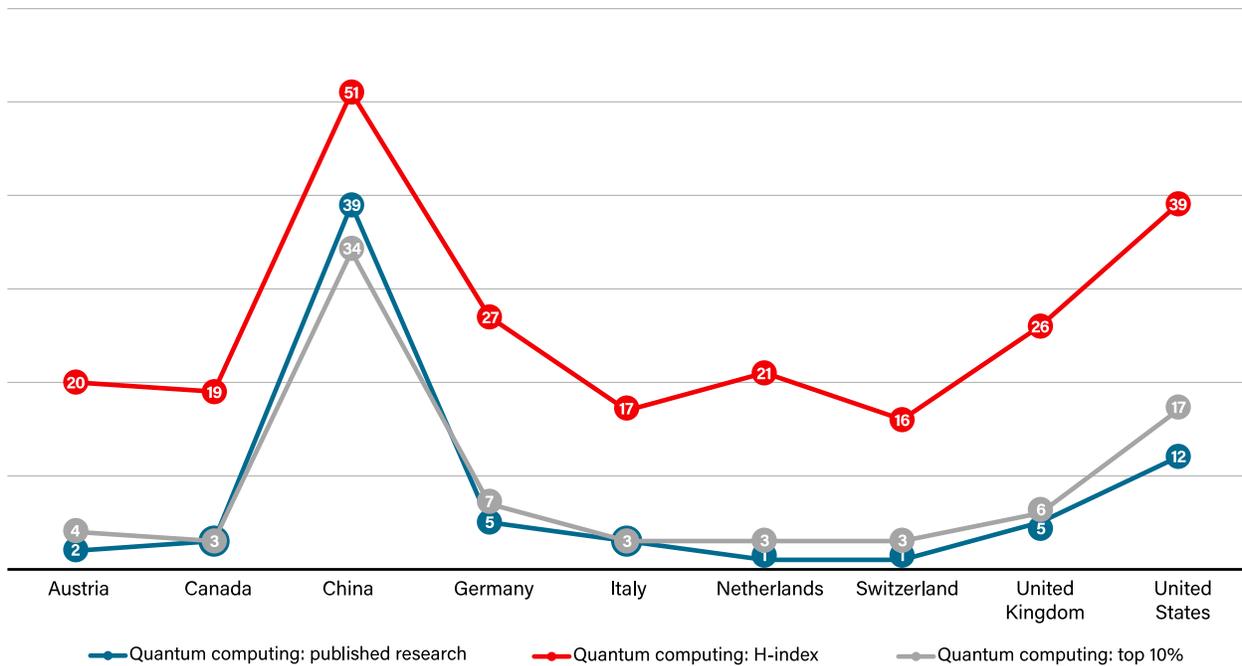
National share of top 10% most highly cited quantum communications publications, 2019-2023



Regarding the pattern of global research leadership based on the top 10% most cited publications, China stands prominently at the forefront, accounting for 34% of this field. The United States follows as a strong second, contributing 17% of these influential works, while Germany rounds out the top three with 7%. Together, these three nations dominate the landscape of quantum communications research excellence, collectively producing 58% of the field's most impactful publications.

2.2.4. Rankings overall insights

Quantum communications research rankings overview



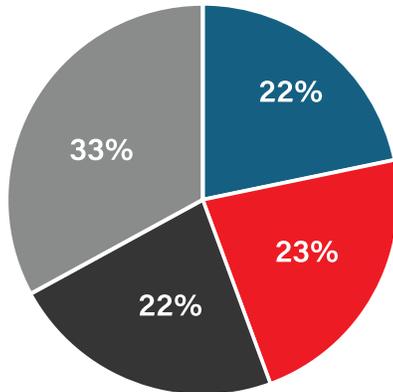
China dominates the quantum communications field with 39% of total publications, significantly outpacing the next closest contributor, the United States, which accounts for 12% of global output. This substantial gap in publication volume is matched by differences in research quality metrics, where China achieves an H-index of 51 and places 34% of its publications in the top 10% most-cited works. The United States exemplifies high-quality research with an H-index of 39 and 17% of publications in the top 10%, despite lower publication volume compared to China.

European countries show varying levels of performance in quantum communications research. Germany leads as the strongest European contributor with 5% of global publications and an H-index of 27, followed by Austria and the United Kingdom, each contributing 5%. Notably, smaller European nations demonstrate efficiency in research quality despite lower publication volumes: Austria achieves 4% of publications in the top 10%, while the Netherlands maintains an impressive H-index of 21 despite contributing only 1% of global publications.

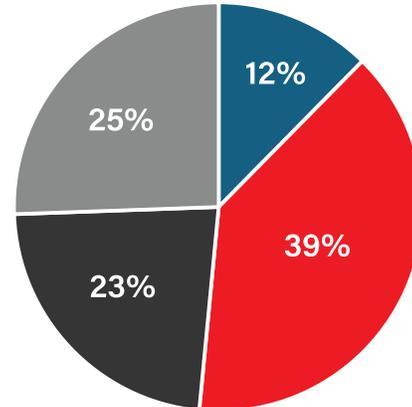
2.3 | Quantum computing vs. quantum communications research

- ▶ The US maintains leadership in quantum computing research while China leads in quantum communications.

Quantum computing published research by region



Quantum communications published research by region



■ United States ■ China ■ European Union ■ Other Countries

China demonstrates leadership in quantum communications with 39% of publications, while maintaining a lower, but still significant position in quantum computing at 23%. This difference of 16 percentage points suggests a strategic focus on quantum communications research in China, likely achieved by specific national priorities and infrastructure investment.

The United States shows an interesting inverse pattern. While ranking second in quantum communications with 12% of publications, it is among the leaders in quantum computing at 22%. This reversal might indicate different strategic priorities between the two nations, with the US maintaining stronger leadership in quantum computing while China focuses more intensively on quantum communications.

European nations present distinct patterns across both fields. Germany and the United Kingdom maintain consistent performance with 5% in both areas, suggesting a balanced approach across the quantum subspecialties.

2.4 | Future research

We are interested in extending our analysis by looking into quantum computing and quantum communications subfields, examining how research productivity and quality vary across specialized subdomains. By mapping publication patterns and quality metrics onto these specialized areas, we will better understand the complex interplay between theoretical foundations and practical applications, potentially revealing emerging trends and opportunities for innovation that might be obscured at the broader field level. We invite contributions from the quantum research community to future editions of this report.

You can reach us at contact@qir.mit.edu.

► Footnotes

¹ Gaida, J., Wong-Leung, J., & Robin, S. (2023). Critical technology tracker. Who Is Leading the Critical Technology Race. A Project by the Australian Strategic Policy Institute. <https://techtracker.aspi.org.au>

² Ibid, H-index (Hirsch index) is an established performance metric used for analyzing the impact of scholarly output. It's a combined measure of quantity and impact. To calculate H-index, a set of papers (e.g. all those on quantum computing from a particular country over a certain time period) has an H-index of N if the relevant authors have published N papers that have N or more citations each. The H-index is based on Times Cited data from the Web of Science database. It will not include citations from non-indexed resources.

³ The top 10% of the most highly cited papers were analyzed to generate insights into which countries are publishing the greatest share of high-quality, innovative and high-impact research. Credit for each publication was divided among authors and their affiliations and not assigned only to the first author (for example, if there were two authors, they would each be assigned half the allocation). Fractional allocation of credit was used for all metrics.

11 | Appendix

Chapter 2 | Academic research

Accenture provided the data for this chapter which was gathered from the Critical Technology Tracker Project by the Australian Strategic Policy Institute¹ (ASPI).

ASPI methodology summary:

The Web of Science (WoS) Core Collection database was used as the primary source of research publication data. WoS Core Collection was chosen because it has well-understood performance characteristics and is used extensively by researchers who study scientific trends. The dataset includes conference and journal publications and excluded bibliographic records that were deemed to not reflect research advances, such as book reviews, retracted publications and letters submitted to academic journals. In addition, data from the Research Organization Registry (ROR) was used to clean institution names, and data from the Open Researcher and Contributor ID (ORCID) database was used to build career profiles for the researchers plotted in the ASPI Talent Tracker.

Country-level quality metrics:

The methodology includes “both the top 10% and the H-index as neither is perfect and both add a unique insight.” In technologies in which first and second place flip depending on which quality metric is used, the race really is too close to call. However, more often, the lead is large and unambiguous, and both metrics are consistent regarding who is leading.”

ASPI methodology states that “The top 10% of the most highly cited papers were analyzed to generate insights into which countries are publishing the greatest share of high-quality, innovative and high-impact research. Credit for each publication was divided among authors and their affiliations and not assigned only to the first author (for example, if there were two authors, they would each be assigned half the allocation). Fractional allocation of credit is a better prediction of individuals who go on to win Nobel Prizes or fellowship of prestigious societies. Fractional allocation of credit was used for all metrics.”

“The number of institutions that a country has in the world’s top 10 institutions is used to illustrate research concentration and dominance. This list is based on the number of papers that the institutions have in the top 10% of highly cited papers.”

Definitions as explained in the ASPI methodology:

Quality Metrics: “Distinguishing innovative and high-impact research papers from low-quality papers is critical when estimating the current and future technical capability of nations. Not all the millions of research papers published each year are high quality.”

Citation: “When a scientific paper references another paper, that’s known as a citation. The number of times a paper is cited reflects the impact of the paper. As time goes by, there are more opportunities for a paper to be cited, so only papers of a similar age should be compared using citation counts (as was done in this report).” This data was

Chapter 9 | Quantum networking testbeds

The dataset was created by merging input from the Center for Quantum Networks (CQN) researchers, QIR professional network and publicly available information by GQI Quantum Computing Report (accessed in June 2024).

Chapter 10 | Quantum processor benchmarking

The dataset of QPUs was composed by a combination of a keyword-based online search and official announcements, references to QPU lists made available to us, and direct query to QPU manufacturers. The data was collected from January 2024 to April 2025.

In particular, a list of known manufacturers was created based on the sources of The Quantum Insider, Olivier Ezratty, and Wikipedia. For each manufacturer, the official website was interrogated to retrieve the indicated benchmarks. For datasets not on manufacturer's websites, we utilized web searches (Google) for official announcements from manufacturers and related news articles.

Additionally, scholarly articles were identified via Arxiv and Google Scholar using the following keywords for benchmarks: Quantum Volume, CLOPS, EPLG, Q-Score, benchmarking.

During this process, additional manufacturers/QPUs were identified and added to the QPU list. Lastly, each manufacturer was contacted for verification of records—either to an existing contact of the QIR team, or to the communications address listed on manufacturer's website. The final list was reviewed by the QIR team and experts in their professional network.

► Footnotes

¹ Gaida, J., Wong-Leung, J., & Robin, S. (2023). Critical technology tracker. Who Is Leading the Critical Technology Race. A Project by the Australian Strategic Policy Institute. <https://techtracker.aspi.org.au>



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