



A PORTRAIT OF THE GLOBAL PATENT LANDSCAPE IN QUANTUM TECHNOLOGIES

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INTRODUCTION

GOAL

This white paper presents an overview of the patent landscape in Quantum Technologies, with a more detailed analysis of the situation in **Quantum Computing, Quantum Communication and Quantum Sensing**.

The analysis is based on alive patents and patent applications that were published **before 30 June 2024**¹.

This is the second edition of this white paper, following the one released in January 2024 (1), which was based on alive patents and patent applications that were published before 30 June 2023².

As such, this new study provides the opportunity to evaluate the situation in terms of patent families³ and the changes over this period.

This study also focuses on the **European position**⁴ in relation to the USA and China, and identifies the main European players in **Quantum Technology**.

This study includes the following topics:

- Comparison with last year's white paper
- Analysis of the main players
- Focus on the situation in Europe

Please note that the **Quantum Technology domain is currently highly dynamic in terms of invention filings** and accordingly the number of patent families may be evolving quite significantly.

IMPORTANT NOTES

- ¹ The reader should take into account that there is an **18-month delay between the date of first filing and the date of first publication**. In other words, this study includes only patent families with a first filing **before 1 January 2023**.
- ² The first study, released in January 2024, was based on alive patents and patent applications that were published before 30 June 2023, that is to say with a first filing **before 1 January 2022**.
- ³ A patent family is a collection of patent applications covering the same or similar technical content. The applications in a family are related to each other through priority claims. (EPO website).
- ⁴ For this study, Europe refers to "Geographical Europe": the 27 EU countries plus the United Kingdom, Switzerland, Norway and Iceland.

1 GLOBAL PATENT FAMILY LANDSCAPE OF QUANTUM TECHNOLOGIES

The details related to the creation of the corpus of patent families are provided in Appendix A.

The figure 1 below shows the numbers of patent families and the respective weights for each of the three segments:

- Quantum Computing
- Quantum Communication (Quantum Cryptography and Quantum Information Networks)
- Quantum Sensing

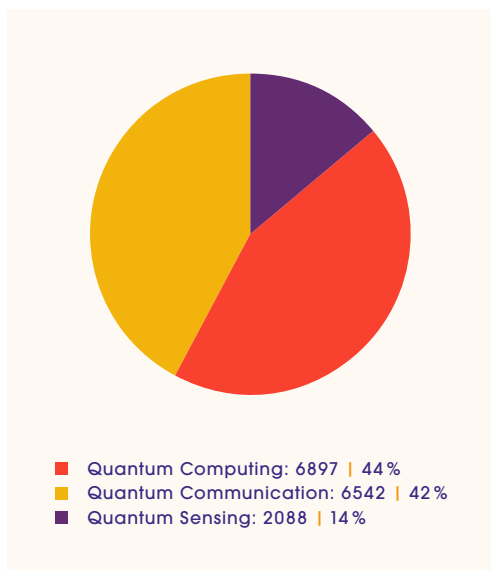


Figure 1: number & weight of patent families by Quantum Technology segment

Quantum Computing and Quantum Communication are noticeably stronger than Quantum Sensing.

This effect is also clear from the graph of first filings by priority date:

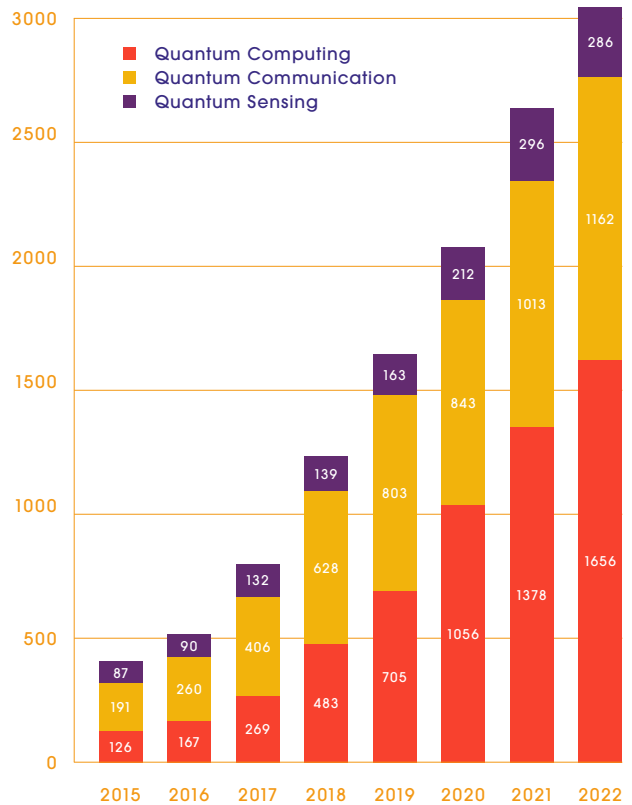


Figure 2: global segmentation – number of patent families by priority date

The average growth per year is quite strong with around 31% overall for the 2017-2022 period, slowly decreasing during the last year.

For Quantum Computing, the average growth over this period is as much as 44%, increasing to 50% last year.

Figure 3 (→ PAGE 6) shows the main players based on the number of patent families, identified by country / region of origin for the USA, China, Europe, Japan.

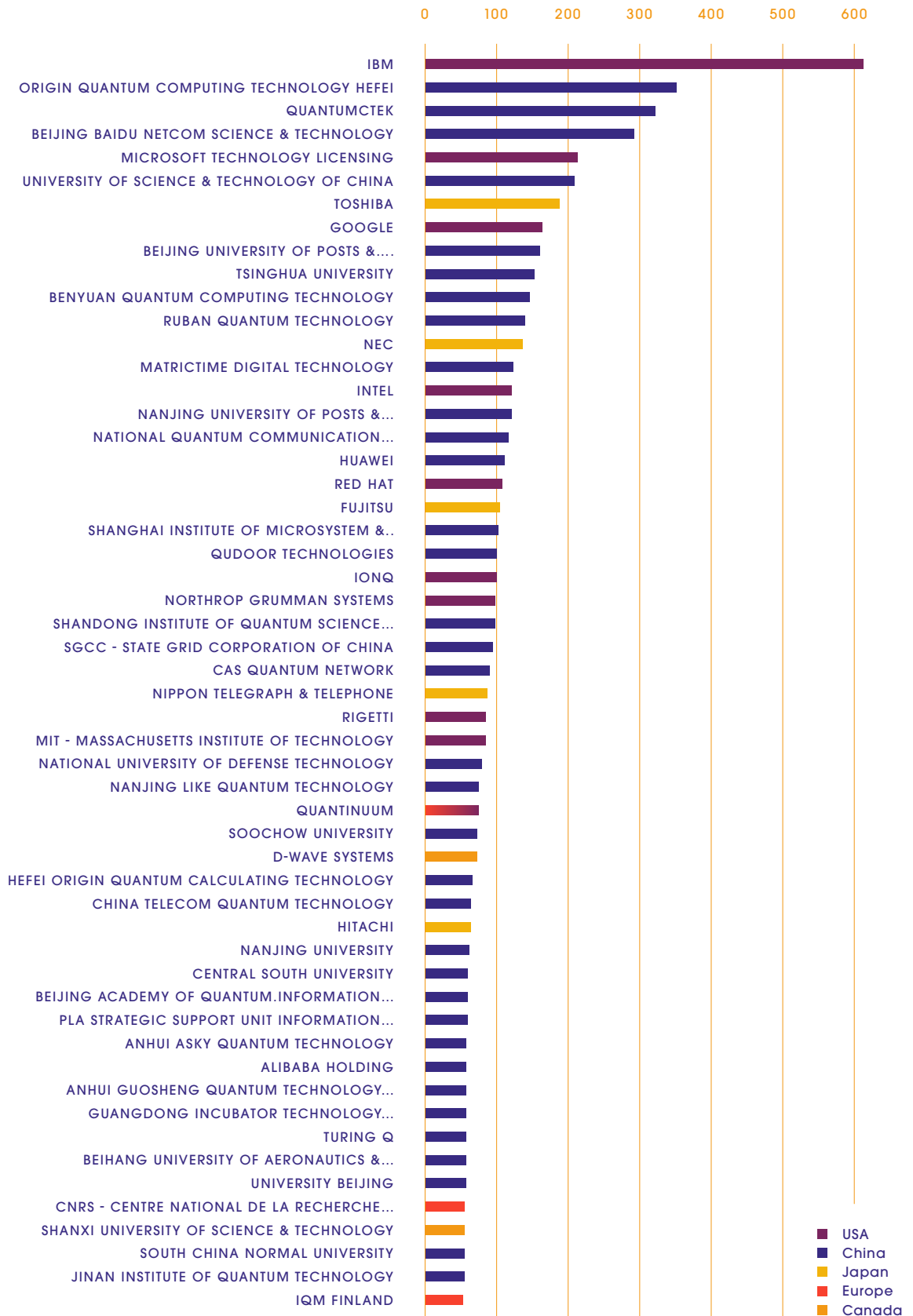


Figure 3: global segmentation - number of alive patent families by main players by country

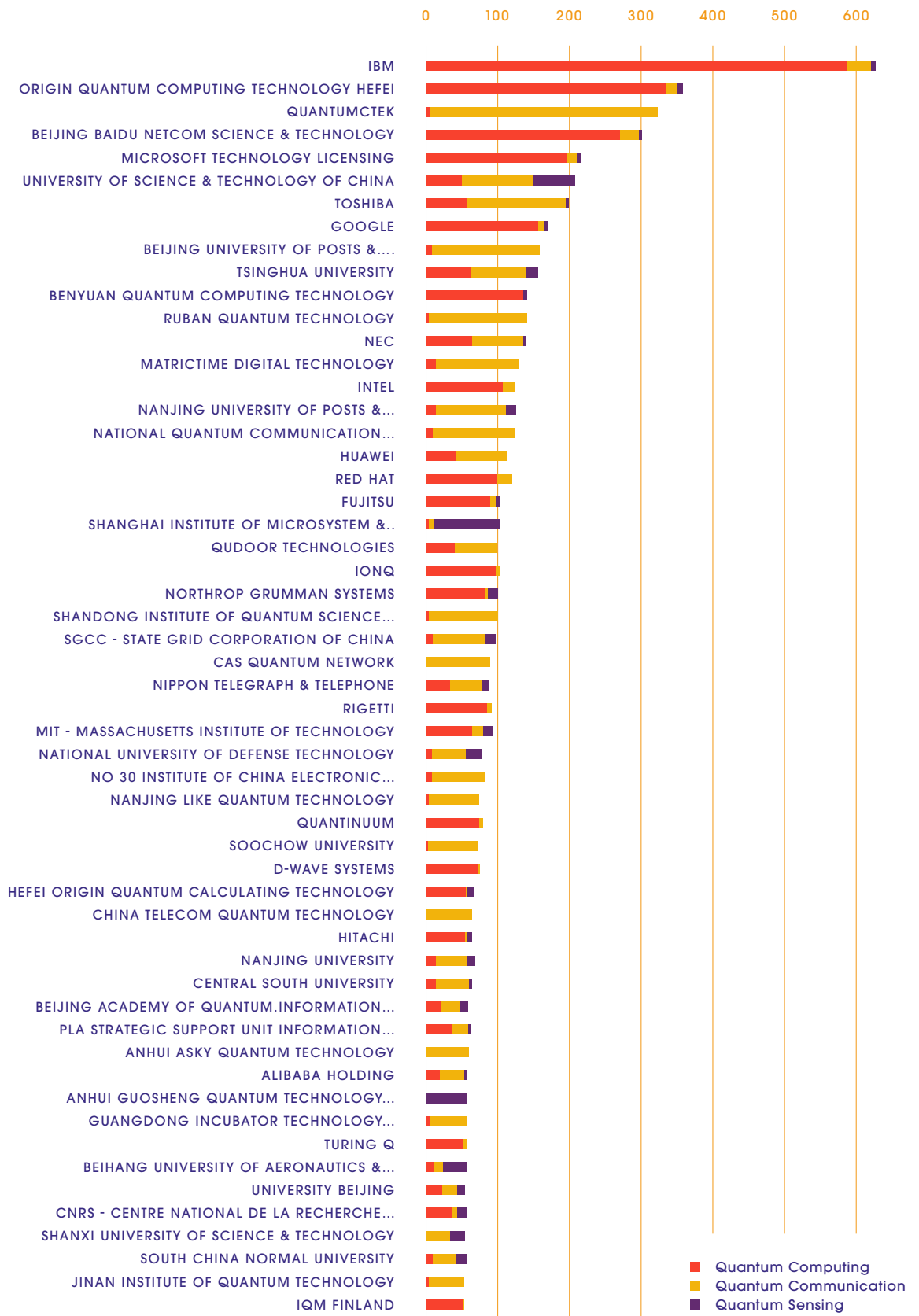


Figure 4: global segmentation - number of alive patent families by main players by domain

A key takeaway from figure 3 (→ PAGE 6) is that **six Chinese companies and academic institutions rank in the top ten** (for the number of alive patent families), along with three companies in the USA and one company in Japan.

IQM Finland is the first-ranked European company in this graph.

Chinese companies are also investing a lot (based on the number of patent families) in **Quantum Computing**, as well as Quantum Communication.

Origin Quantum Computing and **Baidu** are the Chinese leaders in this domain.

Regarding Quantum Communication, this domain is dominated by companies & academic institutions from China and Japan.

However, it is important to take into account that very few Chinese patent families are extended outside China, as discussed below (see table 3).

(→ PAGE 10)

2 COMPARISON WITH LAST YEAR'S WHITE PAPER

2.1 KEY FIGURES IN 2023 AND 2024

In this chapter, we compare the results provided in the white paper from last year (1) based on alive patents and patent applications that were published before 30 June 2023, and the current one, based on alive patents and patent applications that were published before 30 June 2024.

You can download the previous edition (issued in January 2024) from the QuIC website:

[QuIC-White-Paper-IPT-January-2024.pdf](#) (euroquic.org)

Comparing the two patent portfolios (June 2023; June 2024) reveals a significant growth in Quantum Computing and Quantum Communication:

Number of alive patent families by domain	2024 study	2023 study	Growth 2024/2023
Quantum Computing	6897	5040	37%
Quantum Communication	6542	5366	22%
Quantum Sensing	2088	2033	3%
Total	15527	12439	25%

Table 1: comparison between 2023 and 2024 studies

The growth in the period 2023–2024 (though remaining impressive) represents a relative slowdown by comparison to the aggregate growth rate of 31% over the 2017–2022 period.

Table 2 below provides detailed information by country / region, using both 2024 and 2023 data:

Number of patent families by country / region of origin	2024 study	2023 study	Growth 2024/2023	2024 country / region relative weight
USA	4011	3455	16%	26%
China	7900	6022	31%	51%
Europe	1397	1051	33%	9%
Japan	725	609	19%	5%
Korea	644	522	23%	4%
Others	850	720	18%	5%
Total	15527	12379	25%	-

Table 2: 2023 and 2024 comparison – detailed breakdown by country

Europe and China are displaying particularly strong performance in terms of patenting with respectively 33% and 31% growth versus the previous year.

However, for China, we need to put things into perspective. If we consider Chinese international patent families (that is to say, Chinese patent families with at least one extension or a PCT outside China), these represent only 7% of all Chinese patent families.

Considering only these international patent families, the **relative weight of China** for patent families in Quantum Technology **decreases from 51% to 7%**¹ as shown below:

Number of patent families by country / region of origin	2024 study	Ratio of international patent families versus all patent families	2024 country / region relative weight, considering only international patent families for China
USA	4011		49 %
China (with international patent families)	555	7 %	7 %
Europe	1397		17 %
Japan	725		9 %
Korea	644		8 %
Others	850		10 %

Table 3: comparison with international patent families originating from China

Table 3 shows only international patent families originating from China, but with all patent families from all other countries, as all other countries have a much higher ratio of extensions outside the country of origin.

Please refer to the first white paper (1) for a detailed study of international patent families by country.

As indicated in table 2 and table 3, **the weight of China in Quantum Technology is quite different** when we consider only international patent families originating from China (in this case **7%**), rather than all Chinese patent families (in this case **51%**).

When considering international patent families originating from China, **Europe is ranked #2** in Quantum Technology, with 17% of the total, **behind the USA, which represents 49%** of the corpus used.

2.2 MAIN PLAYERS BETWEEN JULY 2023 AND JUNE 2024

In this section, we study the main players in terms of number of patent families **published between July 2023 and June 2024**.

We include all Chinese patent families, not only international patent families originating from China.

The main companies and academic institutions are shown in the figure below (the colour indicates the country / region of origin), based on the number of patent families published between July 2023 and June 2024.

Figure 5 (→ PAGE 11) shows that there are **seven Chinese companies & academic institutions among the top ten** organisations by number of patent families published between July 2023 and June 2024, together with two Japanese companies and one US company.

In Europe, **IQM Finland** has performed most strongly in terms of patents, with **Multiverse Computing** taking second place.

For the USA, **IONQ** is the first “pure player” in Quantum.

As figure 6 (→ PAGE 12) shows, Quantum Computing is the domain where most patent applications are filed, with Quantum Communication in second place. Quantum Sensing is far behind the two other domains.

¹ The two indicators (ratio of international patent families and relative weight of China when considering international patent families) have the same value of 7% in this case.

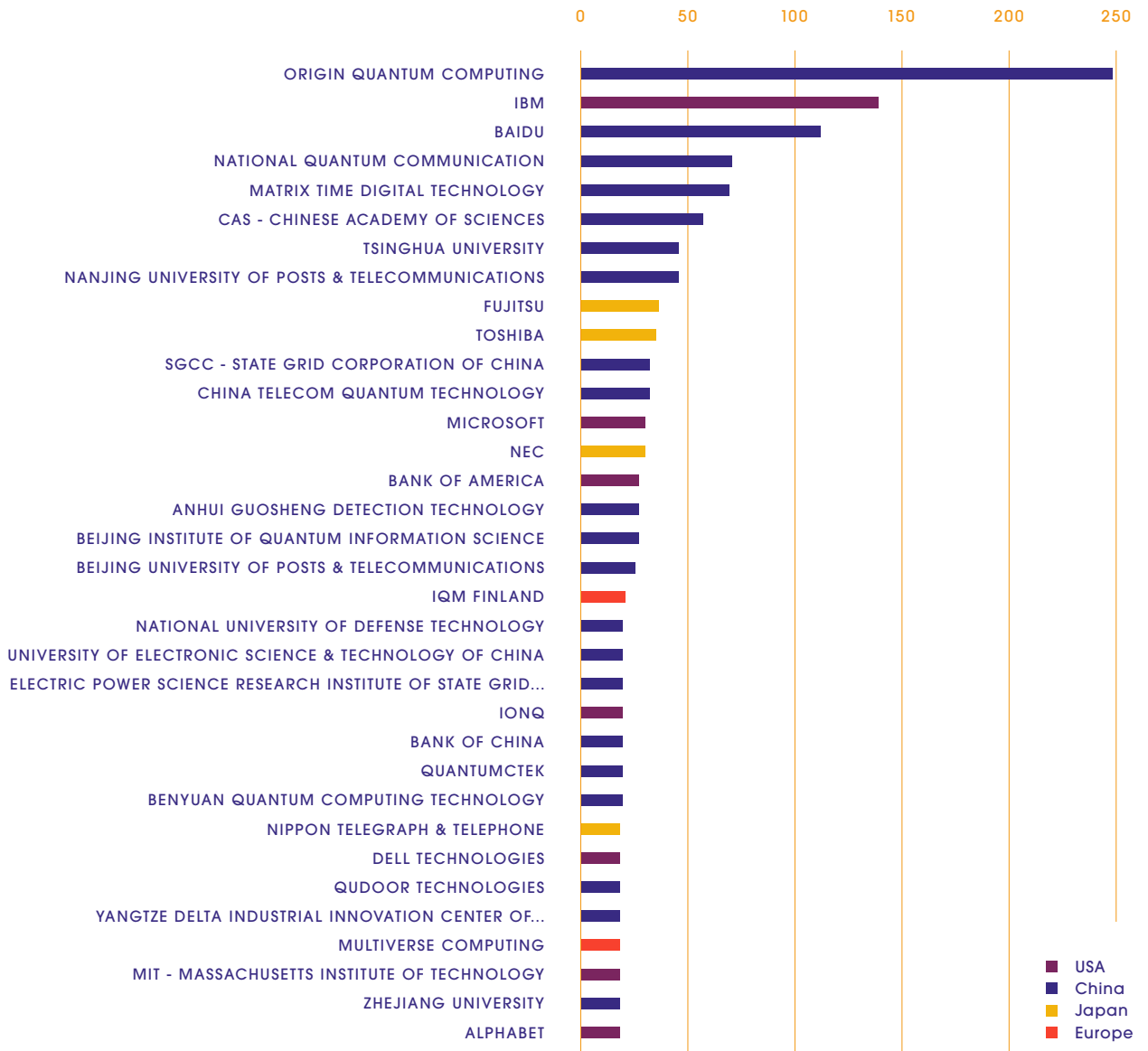


Figure 5: main companies and academic institutions with the highest number of patent families published between June 2023 and June 2024, by country / region of origin

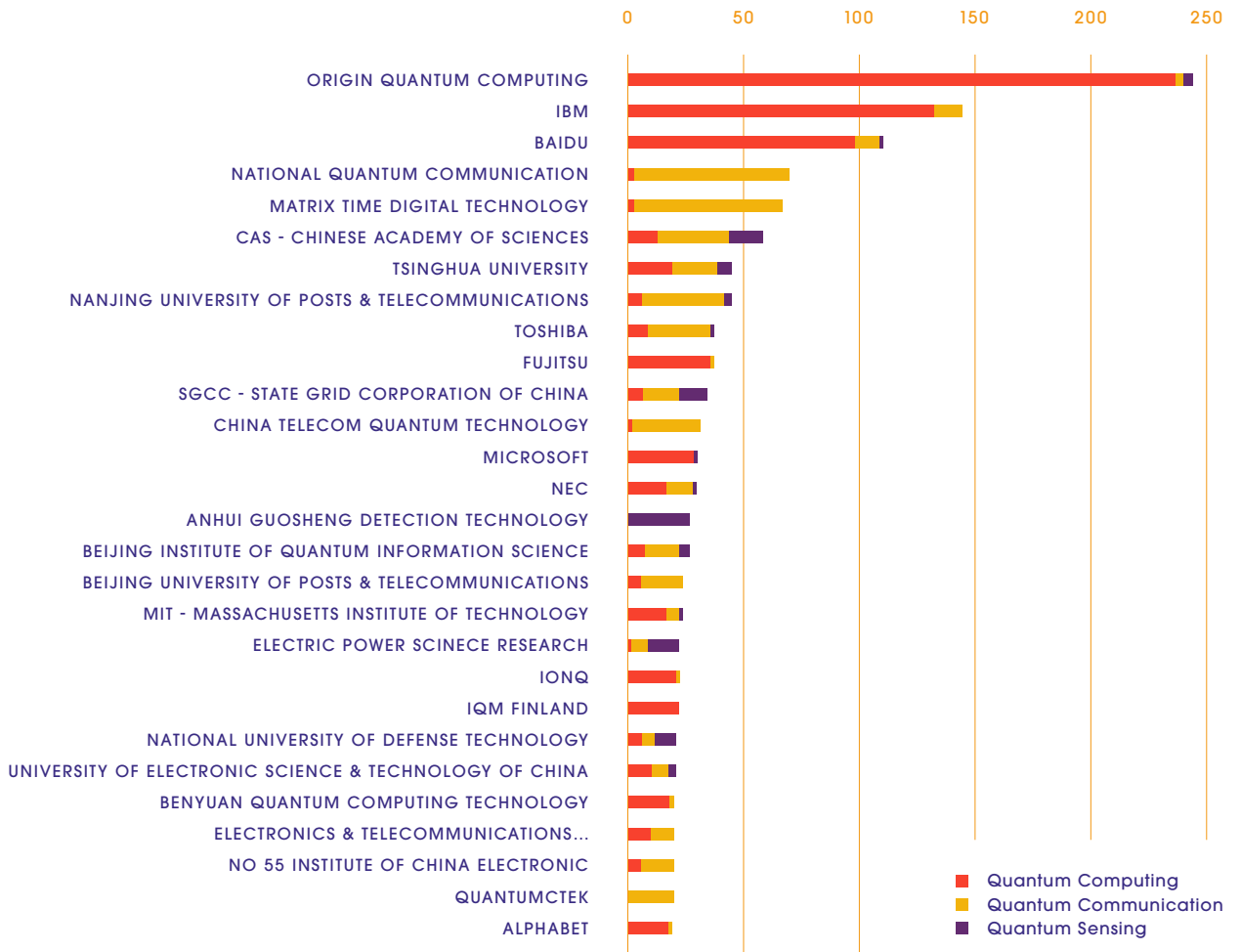


Figure 6: main companies and academic institutions with the highest number of patent families published between June 2023 and June 2024, by domain

3 DETAILED ANALYSIS – IMPROVED CORPUS

3.1 IMPROVED “QUANTUM COMPUTING” CORPUS

This section updates the analysis following some improvements we made to our corpus of patent families:

- The “Quantum Computing” corpus was given a broader coverage, by also including keywords related to Quantum Computing (“Quantum Computing”, “Quantum Computer”, etc.), rather than relying solely on the CPC code.
- A new domain “Quantum Technologies – basic” was created, which includes patent families related to basic or common technologies for the three domains (e.g., source of photon pairs).

Please refer to Appendix A for more details.

(→ PAGE 31)

Implementing these improvements, we obtained a new corpus as described below, significantly larger (13%) than the corpus used in the discussion above.

As shown, the main difference comes from the modification related to **Quantum Computing**.

3.2 INTERNATIONAL PATENT FAMILIES ORIGINATING FROM CHINA

The graph below compares the number of patent families by country of origin.

For patent families originating from China, we considered, based on the priority date:

- the total number of patent families filed each year
- the number of international patent families (patent families with at least one extension outside China or with a PCT)

as well as the number of patent families filed by country / region.

Number of patent families by domain	2024 “enhanced” corpus	Weight of the domain	2024 study (same search request as 2023)	Weight of the domain	Difference between “enhanced” study and 2023 study
Quantum Computing	8672	49 %	6897	44 %	26 %
Quantum Communication	6693	38 %	6542	42 %	2 %
Quantum Sensing	2218	13 %	2088	13 %	6 %
Quantum Technologies – basic	660	4 %			
Total (single inventions)	17583		15527		13 %

Table 4: enhanced corpus

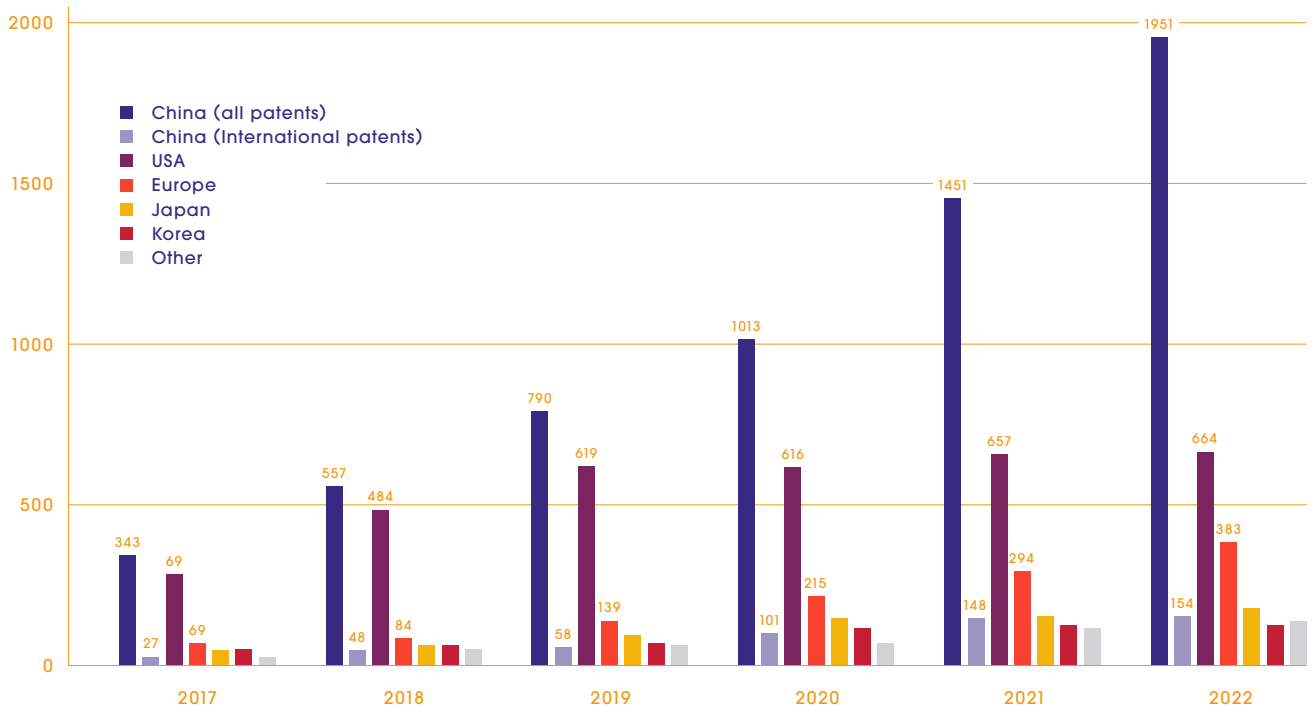


Figure 7: global segmentation – number of alive patent families by year of priority by country / region of origin¹

As figure 7 shows, these two figures for China are quite different.

The number of international patent families originating from China has increased each year, but remains at a very low level.

Accordingly, we will consider only international patent families originating from China in this chapter, instead of all Chinese patent families (international and domestic-only patent families).

When considering only international patent families originating from China, the total corpus decreases by 51% from 17583 to 9009 patent families.

3.3 MAIN PLAYERS

Figure 8 (→ PAGE 15) and 9 (→ PAGE 16) give an updated overview of the main players in Quantum Technology.

¹ for countries / regions other than China, we included all patent families (i.e. both international and domestic-only patent families – please refer to the previous white paper for a detailed analysis of international patent families).

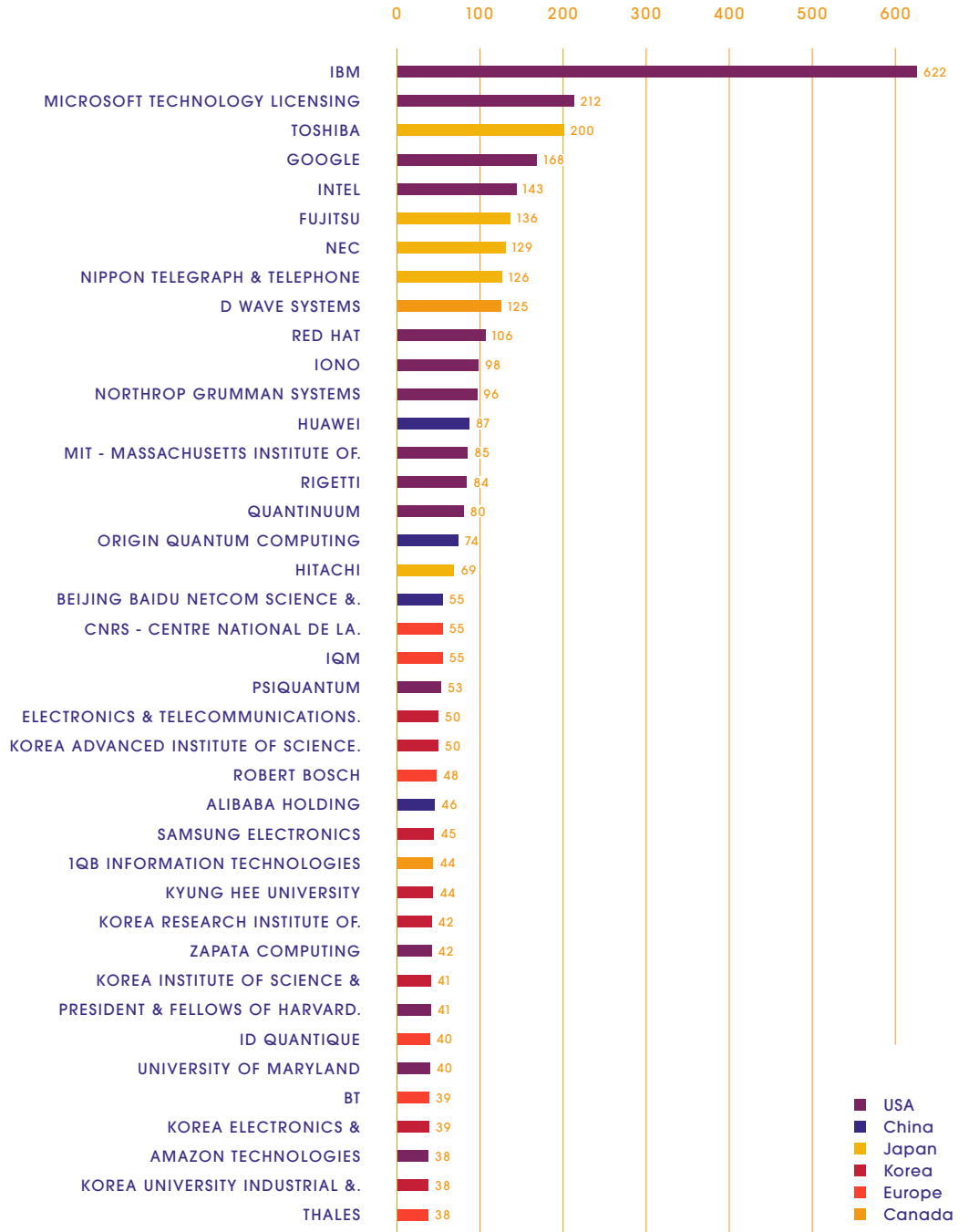


Figure 8: improved corpus - number of alive patent families by main players by country

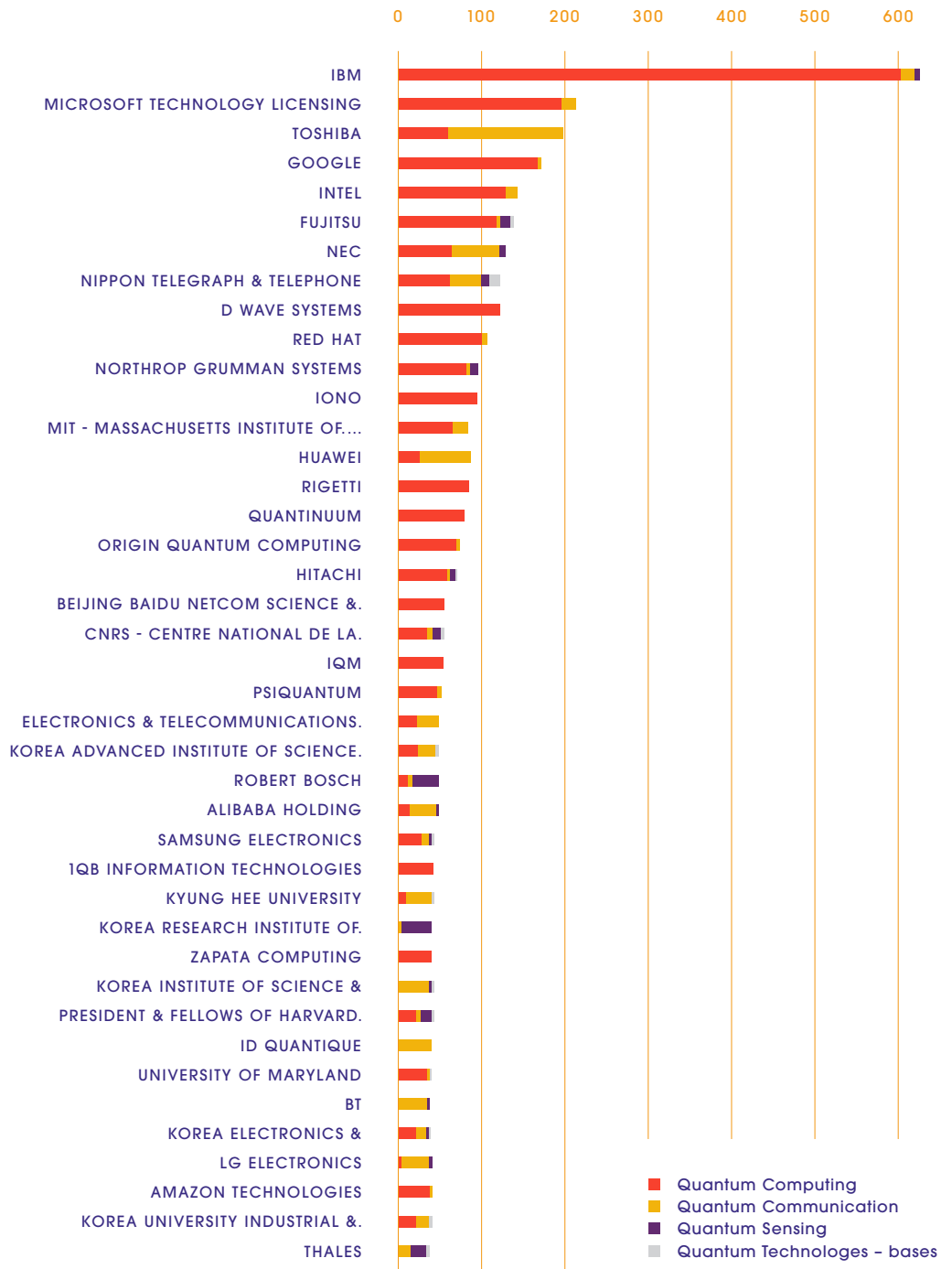


Figure 9: improved corpus - number of alive patent families by main players by domain

The main change we can draw from figures 8–9 (→ PAGE 15–16), when compared to figures 3–4 (→ PAGE 6–7), is in the number of Chinese players and the number of patent families for these players. The top three Chinese companies are now **Huawei, Origin Quantum Computing and Alibaba**, Huawei being at rank #12.

Among the top ten companies and academic institutions (for number of alive patent families), six are US companies, four are Japanese.

Considering “pure players” in Quantum Computing: IONQ (US), D Wave (CA), RIGETTI (US), Quantinuum (US-GB), Origin Quantum

Computing (CN), IQM (Finland), PSI Quantum (US), 1QB information Technologies (CA), Zappata Computing (US), are leading in terms of number of patent families.

Considering companies from Europe: IQM, Bosch, ID Quantique¹, BT, Atos, Thales, are leading in terms of number of patent families.

Considering RTOs from Europe: the French CNRS (National Centre for Scientific Research) and the French CEA (Alternative Energies and Atomic Energy Commission) are leading in terms of number of patent families.

¹ ID Quantique is owned by SK Telekom (South Korea).

4 SITUATION BY COUNTRY / REGION

This section analyses the main players for each country / region of protection (i.e., on each market).

Please note that in this chapter, we consider patents and patent applications in the country / region (i.e., where the application was filed). As such, in China, we consider all applications filed in China.

4.1 SITUATION ON THE US MARKET: US PATENTS

Figure 10 below shows the main players generating US patents (i.e., alive patents and patent applications filed at the USPTO):

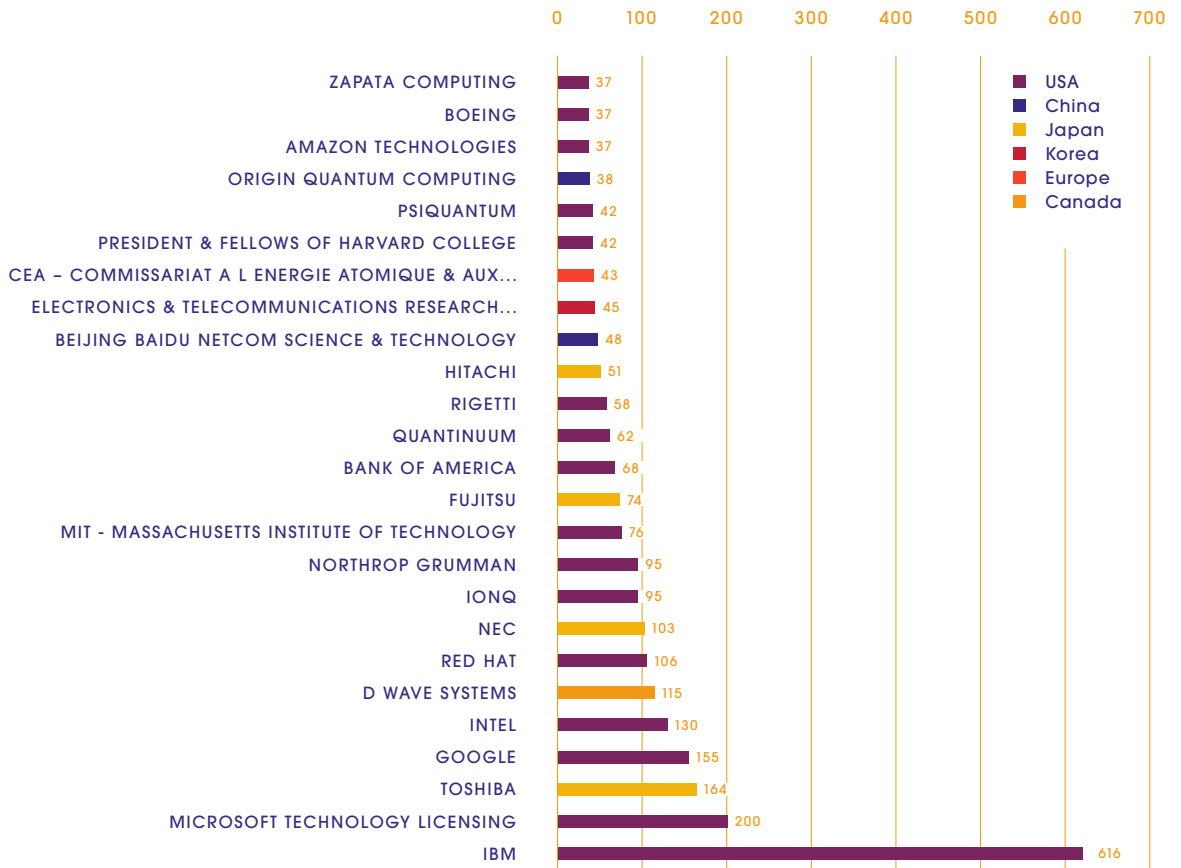


Figure 10: top 25 assignees in Quantum Technologies ranked on number of US patents and patent applications

4.2 SITUATION ON THE CHINESE MARKET: CN PATENTS

Figure 11 below shows the main players generating Chinese patents (i.e., alive patents and patent applications filed at the CNIPA):

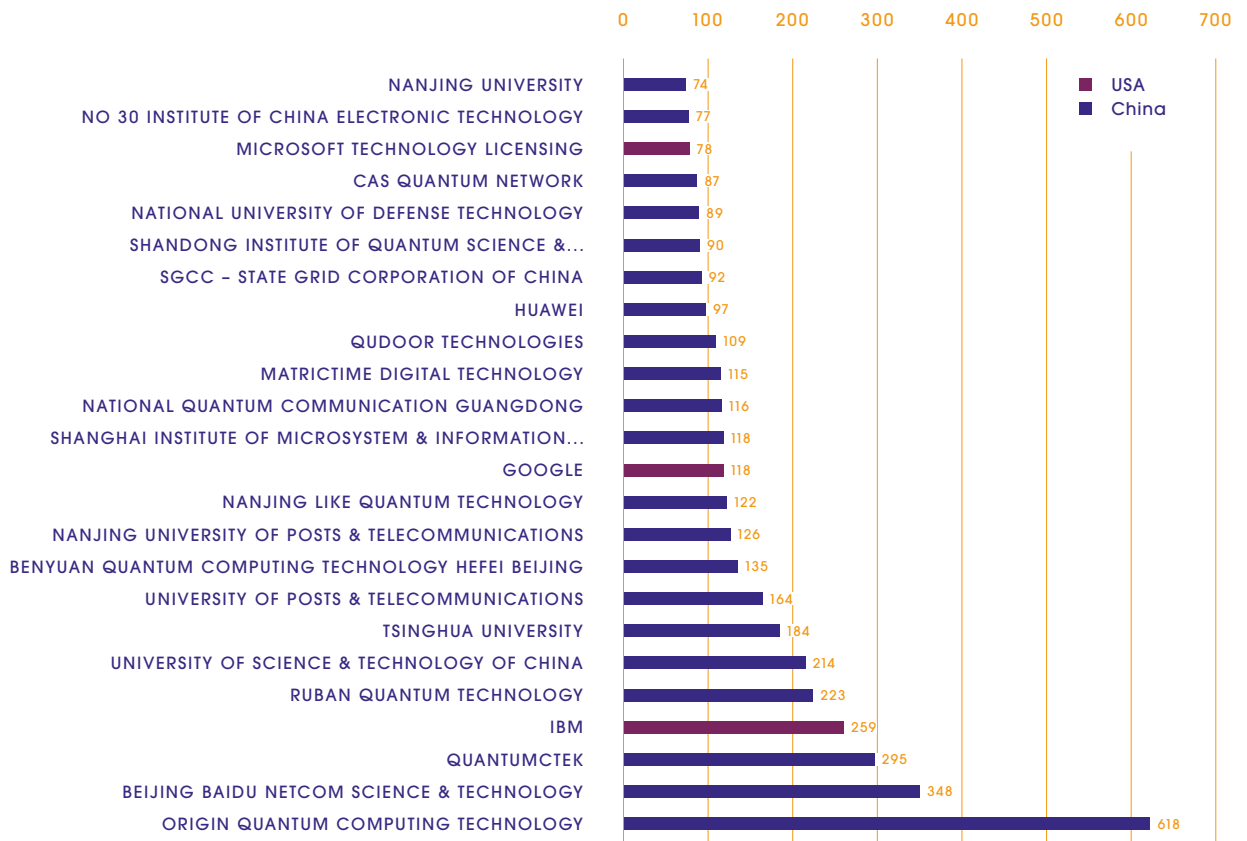


Figure 11: top 25 assignees in Quantum Technologies ranked on number of Chinese patents and patent applications

4.3 SITUATION ON THE JAPANESE MARKET: JP PATENTS

Figure 12 below shows the main players generating Japanese patents (i.e., alive patents and patent applications filed at the JPO):

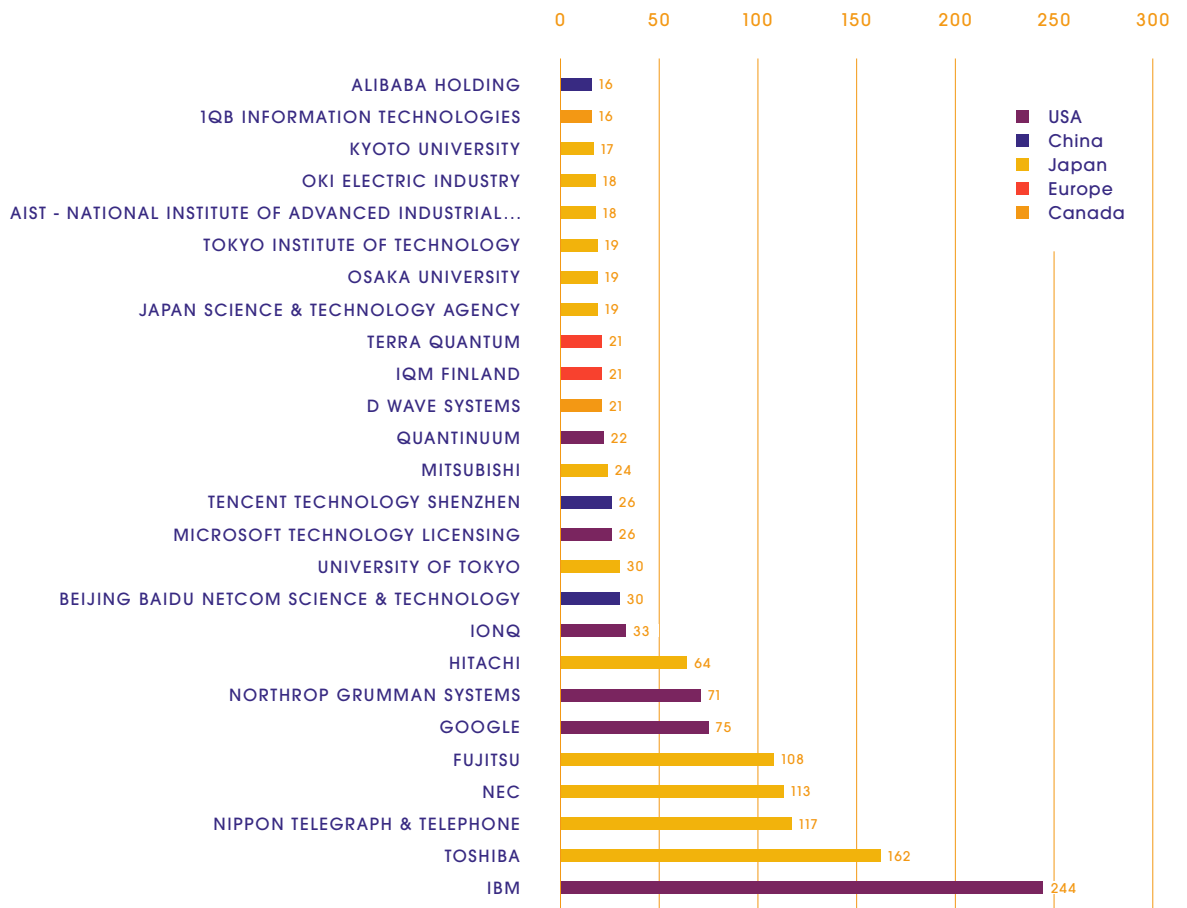


Figure 12: top 25 assignees in Quantum Technologies ranked on number of Japanese patents and patent applications

4.4 SITUATION ON THE EUROPEAN MARKET: EP PATENTS

Turning to focus on the **European market**, we consider all the companies and academic institutions that have filed patents and patent applications **at the EPO**, regardless of the country or origin of the first filing.

The chart below shows the **top 25 assignees for alive patents and patent applications filed at the EPO** (the colour indicates the country of origin):

Among the top 25 assignees (patents or patent applications with the EPO), **the four first positions are taken by US companies**. The CNRS is the first European academic institution, with rank #9, and IQM, at rank #10, the first European company.

European assignees are represented by four RTOs (French CNRS and CEA, Dutch QUTech, German Fraunhofer) **and seven companies** (IQM, Bull Atos, BT, ARQIT, Thales, Multiverse Computing, Pasqal). This represents an **improvement in relation to last year, which had only four European companies**.

While Figures 10–11 (→ PAGE 18–19) show that the USA and China are respectively leading in their own countries, the situation is quite different at the EPO, where European players are far behind US or Chinese competitors.

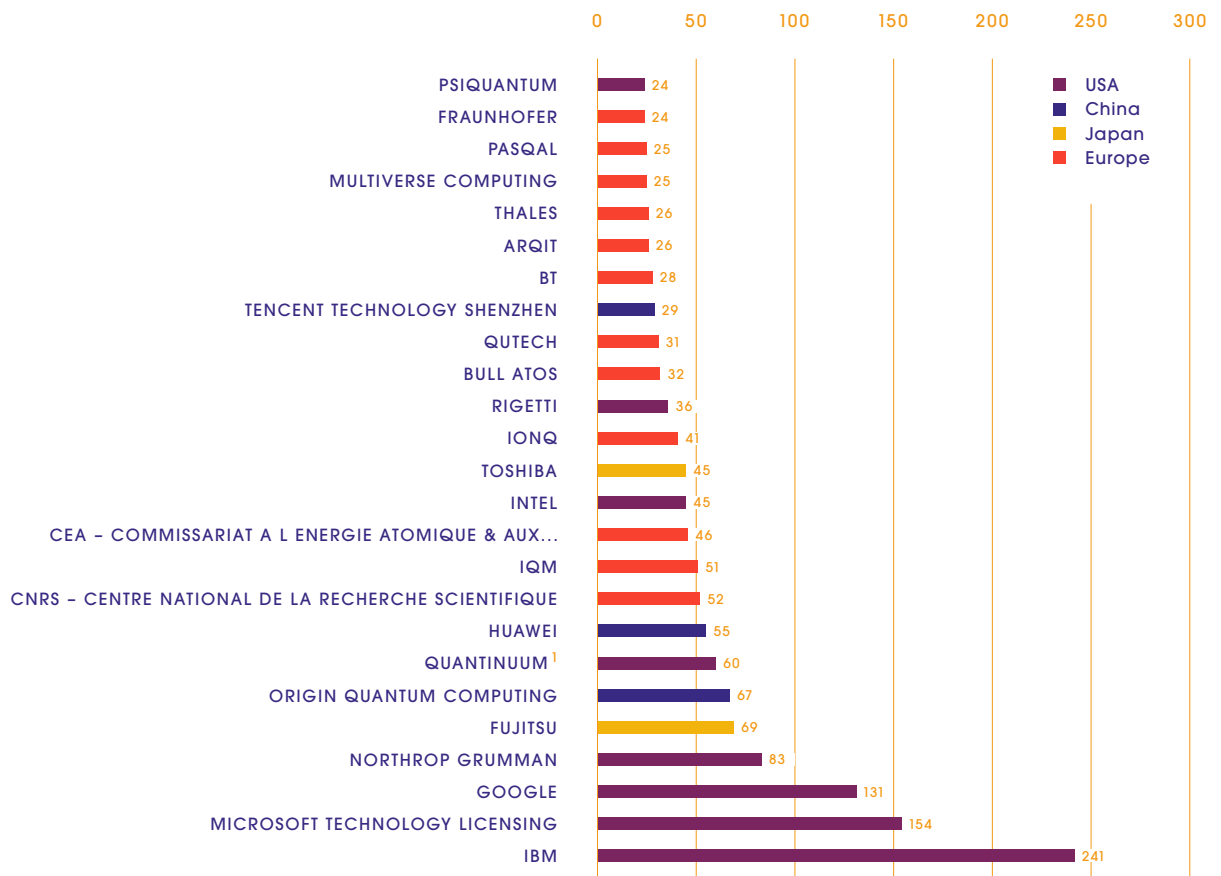


Figure 13: top 25 assignees in Quantum Technologies ranked on number of patents and patent applications filed at the EPO

¹ Quantinuum is formed from the merger of Cambridge Quantum and Honeywell Quantum Solutions.

In fact, EPO patents or applications **originating from a European country** represent only 31% of all published European patents and patent applications in Quantum Technologies, while **US companies and academic institutions have retained a very strong lead with 46%** of European patents and patent applications (see table below), and China has significantly increased its share.

Comparing with last year’s study, we find the number of EPO patents and patent applications keep the same ratio (i.e. the growth rate for EPO patents and patent applications originating in Europe matches the overall growth rate).

Relative weight by country / region of origin	For EP patents		
	2024 study	2023 study	% of growth 2024 vs 2023 ¹
Europe	31 %	31 %	52 % ²
USA	46 %	52 %	32 %
China	9 %	5 %	114 %
Japan	8 %	6 %	80 %
Korea	2 %	1 %	205 %
Other	4 %	5 %	44 %
	100 %	100 %	48 %

Table 5: weight of EP patents and patent applications by country of origin, for the 2024 and 2023 studies

The key points to note are:

- 1) The relative share for the USA in Quantum Technologies for EP patents remains strong, representing the dominant share at **46%**.
- 2) China has significantly increased its share from 5% to 9%.
- 3) Though there has been a significant growth in the number of patents originating from Europe filed at the EPO, **the relative weight has not changed and Europe remains #2 behind the USA on its own market.**

4.5 COMPARISON OF PATENTS BY COUNTRY / REGION

The graph below shows a comparison by country / region of protection (for EP patents ⁴, US patents, CN patents, JP patents), split by country / region of origin:

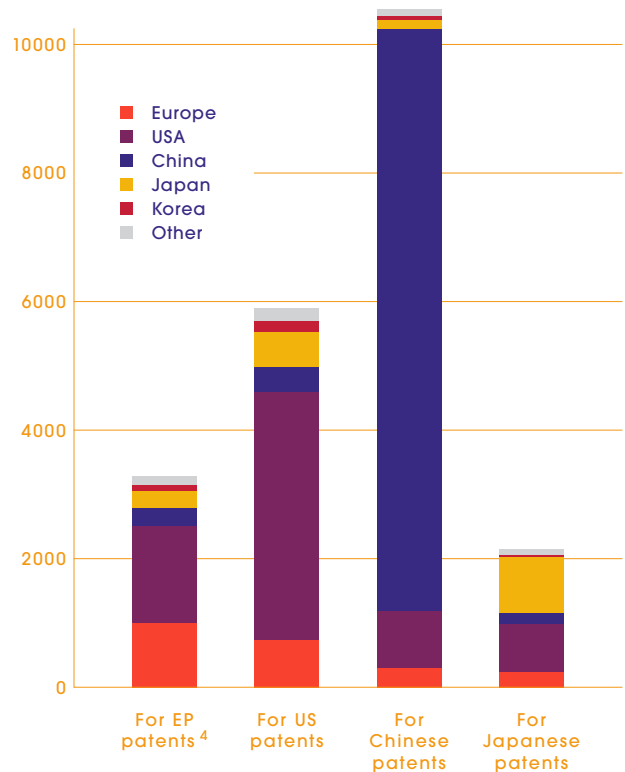


Figure 14: comparison by country / region of protection, split by country / region of origin ³

¹ the percentage of growth between 2024 and 2023 is calculated based on the same searches so as to be consistent.

² please note that the growth of Europe-originated EP patents and patent applications is 52% and the growth of Europe-originated patents and patent applications (overall) is 33%, as indicated in table 2.

³ including all Chinese patents

⁴ EP patents means patents filed at the EPO. In this study, we count only "EP" patents, not the patents to be validated among the 39 members of the EPO.

As already indicated, Europe is the only area where domestic-originated patents do not rank in #1 position.

Below, we give the “reverse” chart, showing a comparison by country / region of origin, split by country / region of protection (i.e., for each patent family originating from a country / region: number of EP patents, US patents, CN patents, JP patents).

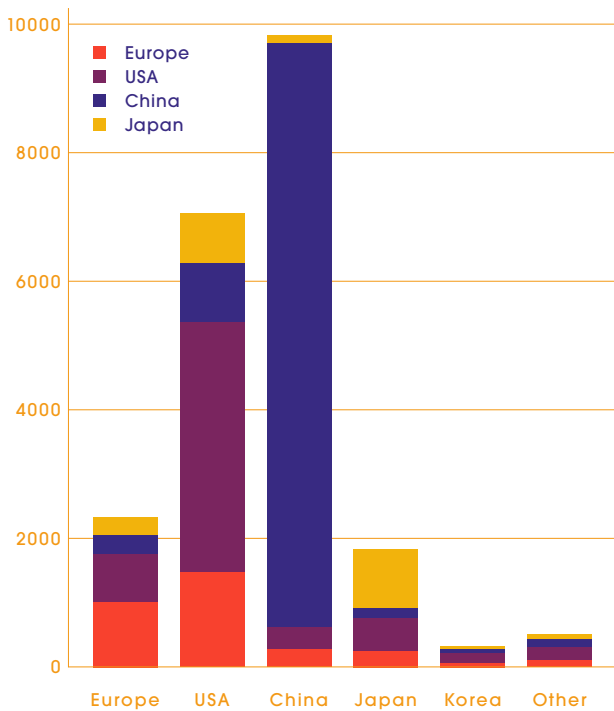


Figure 15: comparison by country / region of origin, split by country / region of protection

Relative weight by country / region of origin	Country / region of protection			
	For EP patents ¹	For US patents	For Chinese patents ²	For Japanese patents
Europe	31 %	13 %	3 %	12 %
USA	46 %	66 %	9 %	36 %
China	9 %	6 %	86 %	6 %
Japan	8 %	9 %	1 %	42 %
Korea	2 %	3 %	0 %	1 %
Other	4 %	4 %	1 %	3 %
Total	100 %	100 %	100 %	100 %
Relative weight of patents	15 %	27 %	48 %	10 %

Table 6: for each country / region of protection, relative weight by country / region of origin

1 EP patents means patents filed at the EPO. In this study, we count only “EP” patents, not the patents to be validated among the 39 members of the EPO.
 2 including all Chinese patents

5 EUROPEAN LEADERS BASED ON THE NUMBER OF PATENT FAMILIES

5.1 EUROPEAN LEADERS BASED ON THE NUMBER OF PATENT FAMILIES

The table below shows the domain split within the corpus of patent families originating from Europe:

Europe - number of alive patent families	Number of patent families	% of total
Quantum Computing	707	45 %
Quantum Communication	568	36 %
Quantum Sensing	245	16 %
Quantum Technologies - Basic	41	3 %
Total	1561	

Table 7: weight of Quantum Technology domains for Europe

The top 50 European assignees, based on their total number of alive patent families, are shown in figure 16. (→ PAGE 25)

As shown in figure 17 (→ PAGE 26), **the three domains are much more balanced in Europe** than internationally – in particular, Quantum Sensing is fairly well represented, while the leading companies in the global comparison are biased heavily towards Quantum Computing.

Focusing on companies:

- In **Quantum Computing**, IQM, Atos, Pasqal, Multiverse Computing, Orca Computing are leading the race.
- In **Quantum Communication**, BT, Deutsche Telekom, Arqit, ID Quantique, Nokia, QBITEKK, Thales have strong portfolios.
- In **Quantum Sensing**, Bosch, Thales, and Quantum Technologies are leading the race.

Focusing on RTOs:

We can see that RTOs are fairly strong in Europe: in particular the CEA, the CNRS, Fraunhofer, QuTech (a collaboration between TU Delft and TNO), Forschungszentrum Jülich, and Oxford University.

- In **Quantum Computing**, CNRS, CEA, QuTech, and Forschungszentrum Jülich are leading the race.
- In **Quantum Communication**, there is currently no strong investment from RTOs, QuTech being most active.
- In **Quantum Sensing**, CEA and CNRS are leading the race.

We can relate this to section 4.4 Situation on the European market: EP patents: 67% of the patent families originating from Europe have an application or a patent filed at the EPO.

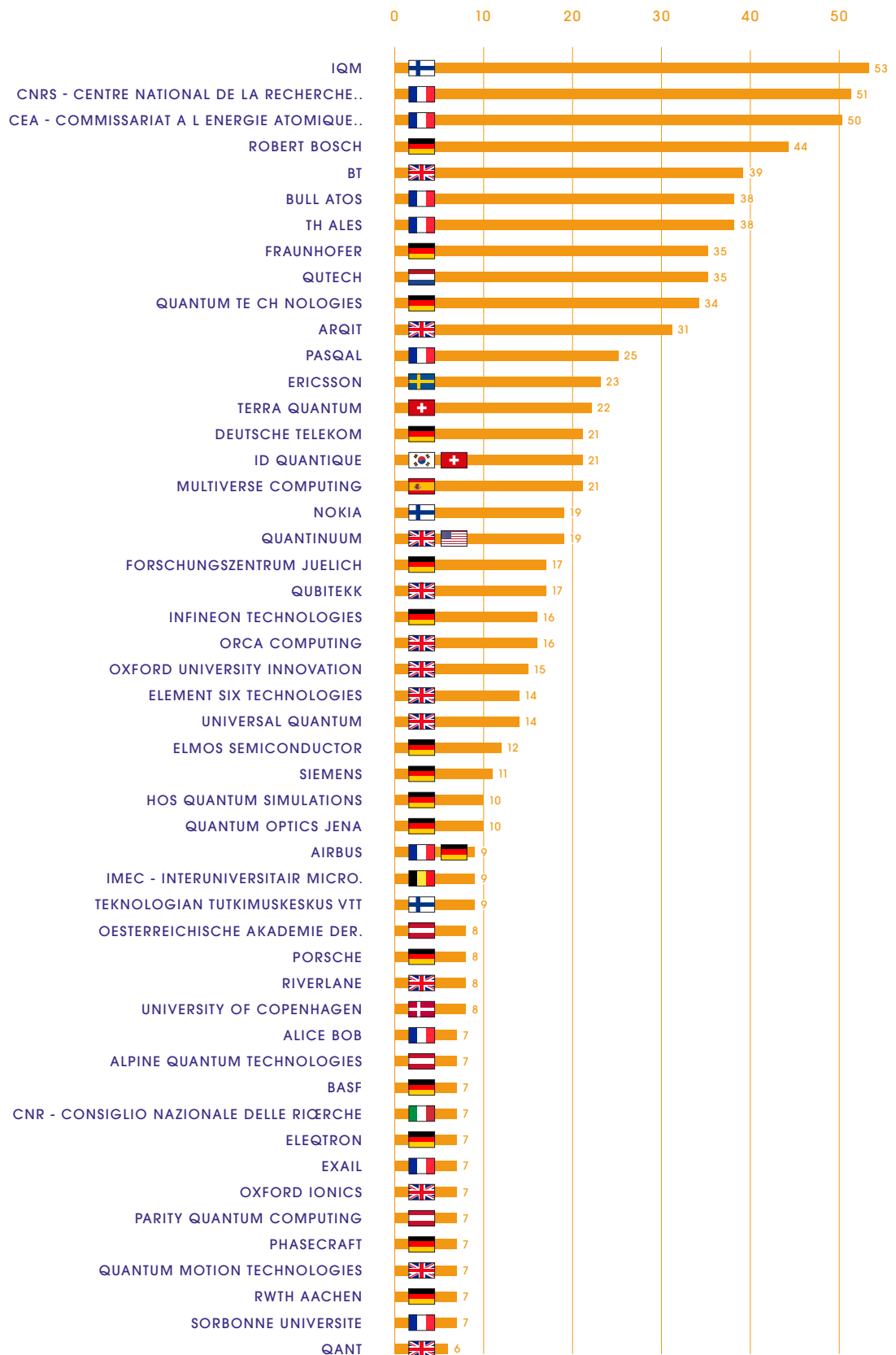


Figure 16: top 50 companies & RTOs in Europe, based on the number of patent families

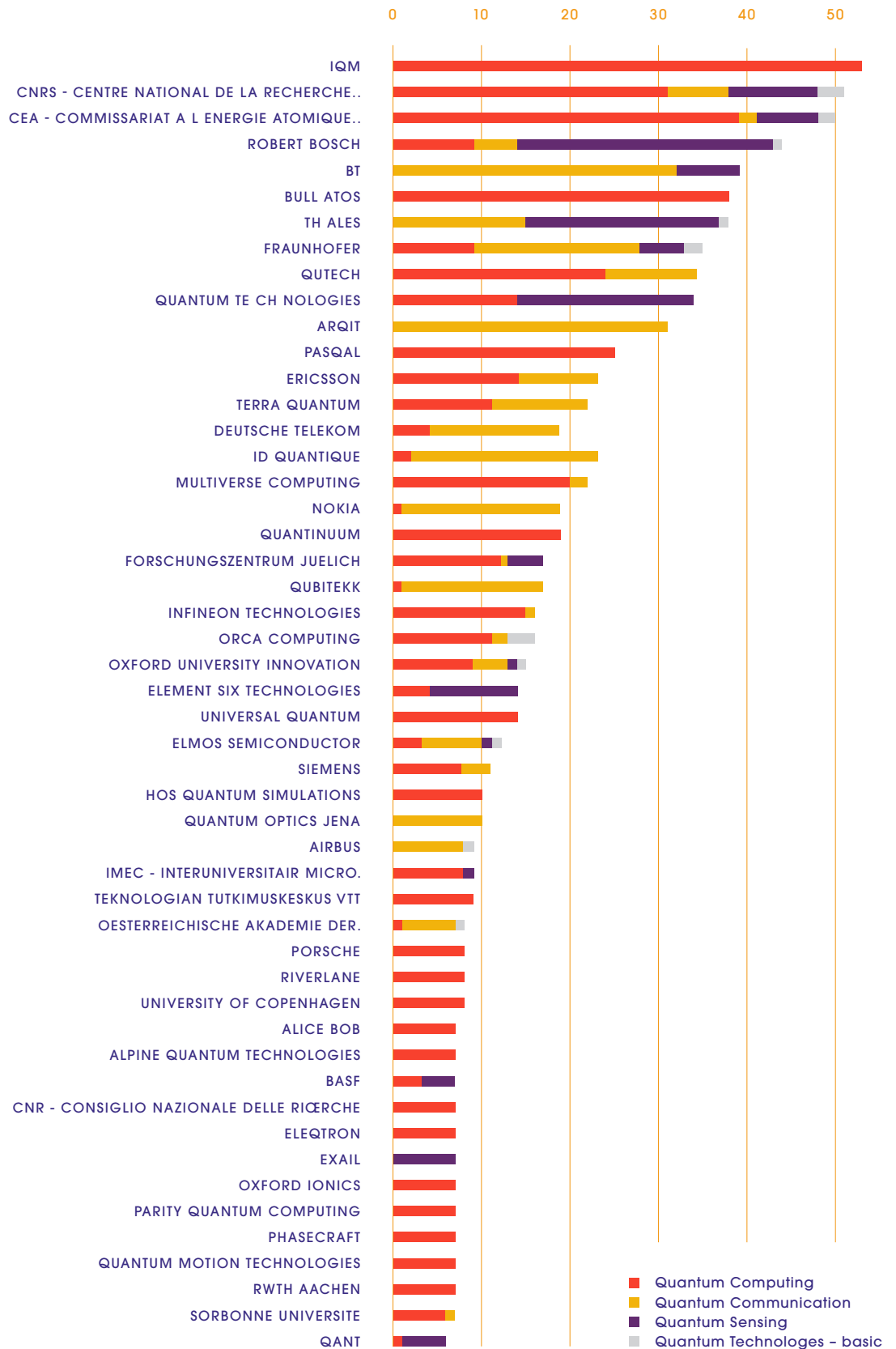


Figure 17: top 25 companies & RTOs in Europe, based on the number of patent families, by domain

CONCLUSIONS

Based on our findings in this white paper, we conclude that the USA and China are in the lead in terms of the total number of filed patent applications¹ related to Quantum Technology (divided into the technology segments Quantum Computing, Quantum Communication and Quantum Sensing):

- **The USA** ranks first in Quantum Computing;
- **China** ranks first in Quantum Communication (though very few of the China-originated patented inventions are extended outside China).

Europe is ranked third in all three segments, whereby **Europe's position in Quantum Sensing is more balanced with the USA and China** compared to its position in Quantum Computing or Quantum Communication².

For European companies and RTOs, the situation for number of European patents and patent applications filed with the EPO remains challenging, despite the fact that very strong growth can be observed for patent-related activities in Quantum Technology from European companies and RTOs (52% growth related to our previous white paper).

Europe ranks second in its own market, with 31% of European patents and patent applications related to Quantum Technology originating from European companies or RTOs, while the **USA is ranked first** with 46% of European patents and patent applications filed with the EPO.

European companies could be at risk, even in their own market, if they do not invest in patents. Dominant patent positions of non-European companies can present obstacles for European companies wanting to commercialise their technology within Europe. **This could hamper potential business for European companies and stifle innovation within Europe.**

A more in-depth analysis would be required to identify which technologies within the realms of Quantum Computing, Quantum Communication and Quantum Sensing are dominated by companies having large patent portfolios.

To achieve strategic autonomy and leadership in Quantum Technology in Europe, European companies and RTOs need to continue and amplify their efforts in patenting activities.

As such, we recommend that:

- More investments should be made by **European states and the EU** to the benefit of European and/or EU academic institutions, companies and start-ups to achieve an intellectual property portfolio, in particular patents, that is on a par with the US and China;
- Funding opportunities provided by European states or by the EU should **promote an ambitious programme related to intellectual property to stimulate the filing of patents related to Quantum Technology at the EPO or at European national offices**;
- Technical assistance regarding patents should be provided by European states or the EU to European SMEs and start-ups in Quantum Technology.

For Europe and the EU, ranking in first place in terms of numbers of patent filings at the EPO is key for supporting European strategic autonomy.

¹ please refer to section 1 Global patent family landscape of Quantum Technologies, figures 3–4. (→ PAGE 6–7)

² please refer to section 5.1 European leaders based on the number of patent families.

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GLOSSARY OF ABBREVIATIONS

CNIPA

China National Intellectual Property Administration

CPC

Cooperative Patent Classification

EPO

European Patent Office

JPO

Japan Patent Office

NMR

Nuclear Magnetic Resonance

NV Centre

Nitrogen Vacancy Centre

PCT

Patent Cooperation Treaty

QKD

Quantum Key Distribution

QulC

European Quantum Industry Consortium

RTO

Research and Technology Organisation

SQIF

Superconducting Quantum Interference Filter

SQUID

Superconducting QUantum Interference Device

USPTO

United States Patent & Trademark Office

DEFINITIONS

EPO member state

China National Intellectual Property Administration

EPO member state

The EPO currently has 39 member states, comprising all the member states of the EU together with Albania, Iceland, Liechtenstein, Monaco, Montenegro, North Macedonia, Norway, San Marino, Serbia, Switzerland, Turkey, and the United Kingdom.

Europe

In this study, Europe includes EU27, UK, Norway, Switzerland, Iceland.

International Patent Family

An international patent family is a patent family having patent family members published by at least two different patent authorities.

For Europe, we also require at least one patent authority to be located outside Europe. We also include in "international patent families" first filings submitted directly under the patent cooperation treaty.

Patent Cooperation Treaty

By filing one international patent application under the PCT, applicants can simultaneously seek protection for an invention in a large number of countries.

Patent Family

A patent family is a collection of patent applications covering the same or similar technical content.

The applications in a family are related to each other through priority claims (EPO website).

Priority Country

The Priority Country is the country where the patent is first filed before being extended to other countries (European Commission IP Helpdesk Website).

Priority Date

The Priority Date is the first filing date of a patent application, anywhere in the world (normally in the applicant's domestic patent office), to protect an invention (European Commission IP Helpdesk Website).

APPENDIX A: CREATING THE CORPORA OF PATENTS AND PATENT APPLICATIONS

We used “ORBIT INTELLIGENCE” (a patent search & analysis tool) from QUESTEL (<https://www.questel.com>) to perform our various searches and analyses relating to Quantum Technology and to create the various corpora of patent families discussed in this white paper.

Please note that any Chinese Utility Model Patents were excluded from the corpus.

Please note also that there is no “perfect corpus”: there is always a trade-off between:

- having the highest number of relevant patent families;
- keeping “noise” to an acceptable level (patent families not directly related to the study).

FOR QUANTUM COMPUTING AND QUANTUM SIMULATION

We use the IPC/CPC code

- G06N-010: Quantum Computing; i.e. information processing based on quantum-mechanical phenomena.

Rationale:

The **rationale** for choosing only this IPC/CPC code is the following:

- other patent studies use the same definition;
- the number of patent families is already quite significant.

For the “improved corpus”, we add the following search:

- ((QUANTUM COMPUTING) OR (QUANTUM COMPUTER?))

And we exclude QKD related patent families:

- NOT ((QUANTUM CRYPTO+) OR (QUANTUM ENCRYPT+) OR (QUANTUM CRYPT+) OR (QUANTUM KEY?) OR QKD)

FOR QUANTUM COMMUNICATION

We divide Quantum Communication into two parts. We use the following CPC codes for Quantum Cryptography:

H04L-009/0852

Quantum cryptography (transmission systems employing electromagnetic waves other than radio waves, e.g. light, infrared H04B 10/00; wavelength-division multiplex systems H04J 14/02; WDM arrangements H04J 14/03)

H04L-009/0855

involving additional nodes, e.g. quantum relays, repeaters, intermediate nodes or remote nodes

H04L-009/0858

Details about key distillation or coding, e.g. reconciliation, error correction, privacy amplification, polarisation coding or phase coding

We use the following CPC code for quantum information networks:

H04B-010/7

Photonic quantum communication

We merge this search based on CPC code with a search based on keywords.

- For Quantum Cryptography
((QUANTUM CRYPTO+) OR (QUANTUM ENCRYPT+) OR (QUANTUM CRYPT+) OR (QUANTUM KEY) OR QKD)

We exclude from this search “**post-quantum cryptography**” which does not use quantum-mechanical properties: ((POST QUANTUM CRYPT+) OR PQC)

- For quantum internet
((QUANTUM NETWORK?) OR (QUANTUM COMMUNICATION?) OR (QUANTUM INTERNET) OR (QUANTUM INFORMATION NETWORK?) OR (QUANTUM TELEPORTATION?))

Rationale

The **rationale** for choosing a mix of CPC code and text-based search is that CPC codes do not currently offer extensive coverage in this domain (a few hundreds of patent families).

FOR QUANTUM SENSING

We use the following CPC codes:

G01R-033/0354
SQUIDS

G01R-033/0356
with flux feedback

G01R-033/0358
coupling the flux to the SQUID

G01R-033/326
Arrangements or instruments for measuring magnetic variables ... involving a SQUID

We combine this search with another search based on keywords:

(ATOMIC VAPOR) OR (COLD CLOUD) OR (TRAPPED ION?) OR (RYDBERG ATOM+) OR ((BOSE EINSTEIN) S CONDENSATE) OR ((SINGLE SPIN?) AND (NMR OR (QUANTUM DOT?)) OR (SQUID+) OR (CHARGE QUBIT?) OR (FLUX QUBIT?)

We add the following searches as well:

- SQUID, SQIF
- Cold atoms: +COLD ATOM+
- NV centres: (NV S CENT+) OR (NITROGEN VACANCY S CENT+) OR (NITROGEN DEFECT? S CENT+) OR (DIAMOND LATTICE?) OR (DIAMOND S NITROGEN VACANCY)

Finally, we restrict these searches to “MEASUREMENT” OR (MAGNETOMET+ OR INTERFEROMET+ OR GYRO+ OR ACCELERO+ OR RADAR? OR LIDAR? OR LADAR? OR SENSOR? OR SENSING)

Rationale

Again, we use a mix of CPC code and text-based search since CPC codes do not currently offer extensive coverage in this domain (a few hundreds of patent families).

FOR QUANTUM TECHNOLOGIES – BASIC

We looked in particular at the creation of photon pairs
(ENTANGLED OR ENTANGLEMENT) P QUANTUM)
OR ((ENTANGLE+ S PHOTON+) OR (PHOTON+ QUANTUM) OR (PHOTON PAIR?))

And we excluded Quantum Computing (G06N-010) from the corpus.

REGARDING COUNTRY OF ORIGIN

For country / region of origin, we selected the patent families based on the **country of priority**:

- Patent families with priority country corresponding to the selected country / region;
- We also added patent families with priority country “WO” (PCT) and country of assignee corresponding to the selected country / region.



CONTACT

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