Saudi Arabia Centre for the Fourth Industrial Revolution

Celebrating World Quantum Day 2024 and Promoting it Nationally

Summary Report April 17-25, 2024

Executive Summary

World Quantum Day 2024 (WQD 2024) was a prominent event organized by the Centre for the Fourth Industrial Revolution Saudi Arabia (C4IR Saudi Arabia) in partnership with various local and international entities. The event was held on April 17 and 18 to elevate public understanding and foster global and national collaboration in quantum science and technology. In addition to the primary goals, the event underscored the importance of educational initiatives and strategic collaborations to drive innovation and economic growth in the quantum sector.

The opening remarks of the event emphasized global collaboration and its benefits for industries. The event featured two key panel discussions focused on promoting quantum science in Saudi Arabia and the role of education in preparing future generations. Additionally, nine (9) leading organizations showcased advancements in quantum computing, communication and cryptography. The event also included a seminar and six technical sessions exploring the impact of quantum technology on various sectors and integrating it into the Saudi economy. Furthermore, student activities aimed to spark interest in this transformative field.

WQD 2024 successfully gathered experts, policymakers, and the public to discuss and gain a better understanding about the potential of quantum technologies. The event achieved widespread success, generating significant media coverage in major news media (SPA, Sabq, etc.) and capturing substantial attention and engagement on social media. Additionally, posting the event on the World Economic Forums platform and listing it as the first Saudi event on the World Quantum Day website, expanded the outreach to a global audience and highlighted the importance of this initiative.

The event concluded with commitments to continue advancing quantum science and technologies through awareness, collaboration, and innovation. The shared insights and discussions from WQD 2024 pave the way for a quantum-powered future with promising global and national development possibilities. Future celebrations of WQD 2025 will be planned to increase national awareness further and prepare a quantum-ready workforce and society.

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Introduction

World Quantum Day (WQD), celebrated on April 14th since 2021, is a global initiative to increase awareness of quantum science and technology. This date, representing the fundamental constants \hbar (reduced Planck's constant) and π in the digits 14/4, underscores their significance in quantum mechanics. WQD showcases the transformative potential of quantum technologies in various sectors and aims to inspire, educate, and engage the public in this exciting field.

The primary goal of WQD is to make quantum science accessible and interesting to a broad audience, including students, educators, and the general public, through interactive workshops, lectures, and demonstrations. Countries around the world, such as Canada, Germany, Australia, China, the United States, and others in the Middle East, enthusiastically participate in these celebrations with activities designed to enhance understanding and engagement with quantum science.

The Centre for the Fourth Industrial Revolution Saudi Arabia (C4IR SaudiArabia) embraced World Quantum Day to promote global collaboration in quantum technology following the recent launch of its Quantum Economy project, which aligns with the World Economic Forum's Quantum Economy Blueprint Network. This celebration is particularly significant for C4IR Saudi Arabia as it marks the first official participation of Saudi Arabia in WQD, highlighting the Kingdom's proactive approach in the quantum field and enhancing our national profile.

The 2024 celebration of World Quantum Day was conducted in collaboration with King Abdulaziz City for Science and Technology (KACST) and King Salman Science Oasis (KSSO). This collaboration enriched the event with a variety of activities, including:

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Main Event: Insightful sessions to discuss the role of quantum science and technology in promoting economic growth and the importance of education in preparing for a quantum-influenced future in Saudi Arabia.

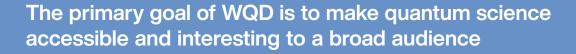


Seminar and Technical In-depth Sessions: A seminar and two technical sessions exploring the impact of quantum technology on various sectors and strategies for integrating quantum computing into the Saudi economy. ✓
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Exhibitions: Displays from leading organizations in the quantum field showcasing quantum computing and cryptography advancements.



KSSO Activities for Students: Engaging activities for students to introduce them to quantum physics and computing, enhancing their understanding of the field's fundamental concepts and applications.



Main Event

An insightful series of discussions with leaders and experts centered on the anticipated impact and prospects in the age of quantum technology took place on April 17th, 2024, as part of the World Quantum Day celebrations. Quantum advancements are set to transform the economy, impacting areas such as economic modeling, financial markets, and supply chain management. Education and awareness are key to unlocking the potential of quantum computing, communication, sensing, and cryptography in these sectors.

The panel sessions aimed to explore education's role in preparing future generations for a quantumdriven economy and to identify challenges and opportunities in leveraging quantum technologies for economic growth and sustainability. In addition, it raised awareness about the potential impact of quantum technologies and discussed the need to integrate quantum concepts into educational curricula and professional development programs.

As part of celebrating World Quantum Day 2024, this event included two sessions:

Promoting Quantum Science, Technology, and Innovation in the KSA

This session explored the challenges and opportunities in leveraging quantum technologies for economic growth and sustainability. It focused on how science, technology, and innovation are critical drivers for thriving in a quantum-powered economy.

Role of Education and Awareness in Quantum Leaps

This session targeted the critical role of education and awareness in driving quantum leaps. Education in public schools and higher education institutions plays a pivotal role in cultivating the next generation of quantum leaders while raising awareness among the public, which is essential for fostering support and engagement in quantum initiatives.

Opening Remarks



Dr. Basma Albuhairan welcomed everyone to a special event celebrating World Quantum Day. In her opening remarks, she highlighted the day's significance in recognizing global efforts and achievements in quantum science, which have the potential to revolutionize various industries. Dr. Albuhairan emphasized we are on the verge of a quantum revolution, with technologies such as Quantum computing's main feature is, communication, and sensing offering transformative possibilities. Quantum computing is particularly emphasized for its ability to solve complex problems in healthcare, finance, and other fields.

Considering the rising investments and projected market growth in quantum technologies, the importance of global collaboration in research and development was emphasized. However, disparities in access to existing technologies were also noted, with the importance of keeping this quantum gap from developing further. The C4IR Saudi Arabia has initiated a new quantum project to address this issue and is preparing to introduce quantum technologies to Saudi Arabia's economy. This project aligns with the WEF>s Quantum Economy Blueprint Network, promoting collaboration between governments, academia, and industry.

The event, itself, was part of celebrating WQD by raising public awareness, engaging stakeholders, and fostering discussions on quantum-related policies. The keynote also underscored the transformative potential of quantum advancements in various sectors, such as pharmaceuticals, industry, and finance and highlighting the importance of education in this area.

Finally, Dr. Basma expressed gratitude to the organizers, partners, and participants before concluding with a call to embrace the journey toward a quantum-powered future in Saudi Arabia.

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Session 1 - Promoting Quantum Science, Technology, and Innovation in Saudi Arabia



This panel discussion featured from left to right Haitham AlFaraj, CTO, Saudi Telecom Company (stc).; Dr. Talal Alsedairy, Senior Vice President R&D, KACST; Simon Patkovic, VP Quantum Safe Solutions, ID Quantique (IDQ); Meshal Almashari, Director, Digital Strategy & Investment Department, Saudi Aramco; and moderator Hani Alhemsi, Acting Director of Technology, Growth, Research, and Studies Expert, Ministry of Communication and Information and Information Technology (MCIT).

The session aimed to identify the current landscape of quantum research, development, and investment in the KSA; explore the potential to revolutionize various sectors, from computing to communication, to position the KSA at the forefront of this transformative field; and discuss strategies for fostering collaboration among government, industry, technology companies, and academia to accelerate quantum innovation. It also aimed to raise awareness of the significance of quantum science and its potential applications in the KSA and explore the role of policies and regulations in supporting the growth of the quantum ecosystem in the KSA.

Significant global investment in quantum technologies was discussed, with projections indicating robust growth in the quantum technology market. The discussions emphasized the importance of national and international collaboration to leverage these advances effectively. A key theme was the national initiative to create a platform for integrating quantum technology into Saudi Arabia's economy, aligning with global efforts to enhance national quantum capabilities.

Additionally, the session emphasized the critical need for a united front among academia, industry, and government to harness quantum science's transformative power. It advocated the establishment of a robust, collaborative ecosystem that integrates these advanced technologies into national socioeconomic frameworks. By cultivating such synergy, Saudi Arabia positions itself not merely as a participant, but as a leader in the global quantum revolution, setting a benchmark for innovation and pioneering groundbreaking technologies that could redefine the future landscape.

Saudi Arabia Centre for the Fourth Industrial Revolution

Session 2 - Role of Education and Awareness in Quantum Leaps



This panel discussion featured Prof. David Keyes, Senior Associate to the President and Director, Extreme Computing Research Center, King Abdullah University of Science and Technology (KAUST); Prof. Dr. Ibtesam Badhrees, Advisor and Supervisor of Programs and Events at KSSO; Dr. Wasiq Bokhari, Chairman, PASQAL; Dr. Haifa R. Jamal Al-Lail, President, Effat University; and moderator Dr. Muhamad Felemban, Research Center Director, Intelligent Secure System, King Fahd University of Petroleum and Minerals (KFUPM).

The session assessed the current state of quantum education and awareness in the KSA, emphasizing integrating quantum concepts into educational curricula at various levels, from public schools to higher education. Discussions also explored the critical role of media and public engagement in enhancing quantum literacy across the general population, positioning quantum science as a pivotal area of knowledge for the future workforce.

Key takeaways highlighted the urgent need for a cohesive national strategy for quantum technology that aligns with the efforts of government bodies, academic institutions, and industry leaders. This strategy would not only support research and development, but also foster innovation in strategic areas crucial for national growth. Panelists highlighted the importance of creating robust educational programs that embed quantum science and technology concepts within existing curricula, enhancing awareness, and preparing students for future challenges.

Additionally, the panel recommended establishing ongoing programs that facilitate interaction between Kindergarten through Grade 12 students and research centers. These programs would involve regular visits and practical workshops to increase hands-on experiences and engagement with quantum technologies. Such initiatives are essential for building a knowledgeable and skilled workforce ready to contribute to and benefit from quantum science and technological advancements.

Closing Remarks

Dr. Basma Albuhairan expressed gratitude for a successful World Quantum Day event and emphasized the optimistic future of quantum technologies in Saudi Arabia. She highlighted insightful discussions from the sessions that explored the transformative potential of quantum technologies across computing, communication, and sensing. She reinforced the crucial role of collaboration between the government, industry, and academia for unlocking this field's full potential.

Furthermore, she suggested expanding World Quantum Day celebrations in the future to raise national awareness about the significance of quantum collaborations for driving innovation and economic growth. Additionally, she called attention to the critical role of education in building a quantum-ready workforce and society as integrating quantum concepts into higher education and public programs is essential for future generations.

C4IR Saudi Arabia underscored its unwavering dedication to propelling the advancement of quantum science and technologies. This commitment is manifested through a three-pronged approach: fostering public awareness, nurturing collaborative efforts, and spearheading innovation. In closing, the Center extended an invitation to embrace a spirit of relentless curiosity, exploration, and collaboration. Through partnerships and collaborations, the immense potential of quantum technologies can be unlocked, which would pave the way for a brighter future brimming with new possibilities.

Seminar and In-depth Technical Sessions

An insightful series of discussions with leaders and experts was held that centered on the anticipated impact and prospects in the age of quantum technology. Quantum advancements are set to transform the economy, impacting areas such as economic modeling, financial markets, and supply chain management.

The in-depth technical sessions included:

- Seminar (April 18): C4IR Saudi Arabia, in collaboration with Oliver Wyman, is launching an awareness seminar series with an inaugural panel discussing the revolutionary impact of quantum technology on global industries. The session explored how quantum mechanics is transforming computing, communication, sensing, and more, promising significant advancements in fields like material science, pharmaceuticals, finance, and cybersecurity.
- **Technical Sessions on Quantum Computing and Cryptography (April 18-17):** These sessions explored the forefront of quantum technology with sessions focused on the latest developments in quantum computing and cryptography, highlighting their applications and potential to revolutionize industries. Saudi Aramco, PASQAL, IBAM were among the participants in these sessions.



Seminar - Saudi Arabia and the Rise of the Quantum Economy



This panel discussion featured Mohammad Al-Sayairi, Head of Quantum Computing, Saudi Aramco; Dr. Sami Mahroum, Director of Public Policy, Oliver Wyman; Dr. Mohammad Al-Shareef, General Manager, National RDI Observatory, Research, Development, and Innovation Authority (RDIA); Prof. Dr. Ibtesam Badhrees, Advisor and Supervisor of Programs and Events at KSSO, and moderated by Dr. Basma Al-Buhairan, Managing Director, C4IR Saudi Arabia.

This insightful panel delved into how Saudi Arabia can strategically position itself as a leader in this emerging technology by examining the immense potential of quantum computing to accelerate innovation and research in key industries and strategies for Saudi Arabia to become an early adopter, enabling businesses with a competitive edge in utilizing quantum computing. It also established a vibrant quantum ecosystem to attract global investors and top talent and to harness quantum technologies to address national challenges.

The discussion revolved around some of the challenges facing quantum computing uptake in the Kingdom, such as the limited pool of specialized quantum computing researchers and engineers. In addition, participants highlighted start-up costs and infrastructure requirements for quantum research facilities, as well as the need for clarity and confidence regarding areas of applications where quantum computing bets will yield high returns. The panelists agreed that Saudi Arabia needs to invest in pilot projects. They suggested that a quantum club be set up to socialize the emerging field across industries and seek international collaborations that help identify areas of success in this rapidly evolving field.

Technical Sessions Day 1

The first day, April 17, involved three (3) one-hour sessions, including presentations and the interactive Q&A. The first day's sessions highlighted major national initiatives, announced during LEAP 2024, the Saudi Accelerated Innovation Lab (SAIL), and the Quantum Valley (QV). Saudi Aramco's expert leaders delivered both presentations.

Additionally, Quantinuum presented a technical session detailing a major quantum hardware technology: Trapped Ion. Below is an overview for each of the three (3) sessions.



Session 1: Saudi Accelerated Innovation Lab, Mohammad Al Jalaly, Saudi Aramco

The session provided a deep dive into the latest Saudi Aramco digital venture, the Saudi Accelerated Innovation Lab. The session detailed its evolution and strategic vision, aiming to elevate Saudi Arabia's presence in the global digital economy. Initiated in 2020, the SAIL program evolved from enhancing IT infrastructure testing to fostering an innovation-centric environment, culminating in establishing SAIL in 2023. SAIL is designed to integrate operational testing with innovation, focusing on co-development and startup incubation to generate impactful digital solutions nationally. This initiative emphasized creating new digital products, ventures, and intellectual properties to enrich Saudi Arabia's digital economy, with the clear goal of establishing a comprehensive ecosystem that attracts top talent and fosters breakthrough innovations in the digital sector.

Session 2: Quantum Valley, Muhammad Al Saiyari, Saudi Aramco



This session highlighted the Quantum Valley initiative, aimed at establishing Saudi Arabia as a leader in quantum technology. The program involves Saudi Aramco and intends to develop and commercialize quantum technologies to achieve economic advantages across sectors. With a phased approach spread over a decade, the initiative focuses on talent development, integrating quantum applications into the economy, and fostering a robust quantum technology ecosystem to maintain global competitiveness and realize substantial economic opportunities by 2040.

Session 3: Trapped Ion Quantum Computing, Current Advancement and Future Plans, Anand Shah, Quantinuum



Thissessionshowcased significant advancements in guantum computing. Quantinuum announced a transition from the noisy intermediate-scale quantum (NISQ) era to a more reliable quantum computation phase, leveraging logical gubits that dramatically reduce error rates and enhance computational reliability. The session also highlighted Quantinuum's development of the most reliable logical qubits to date, achieving 800X improvements in fidelity with 14,000 errorfree experiments, marking a major milestone in guantum computing. They also outlined their fullstack technology approach, including advanced circuit compilation and quantum error correction, tailored for enterprise and scientific applications. The roadmap presented emphasizes scalability, fidelity, and usability, integrating with thirdparty platforms to support diverse quantum architectures.

Technical Sessions Day 2

The second day, on April 18th, included three (3) interesting technical sessions, each lasting one hour that included a presentation and an interactive dialogues with the attendees. These sessions covered in detail two main approaches to quantum modalities, superconductivity, and cold atom quantum computing, provided by IBM and PASQAL, as well as the future insights of quantum cryptography.

Below is an overview for each of the three (3) sessions.

Session 4: Superconducting Quantum Computing, Current Advancements, and Future Plans, Ahmad Al Qatatsheh, IBM



This session outlined IBM's mission to make quantum computing useful and secure globally. It focused on maintaining the largest fleet of utilityscale quantum systems available via the cloud, which supported the development and scaling of quantum computing from hardware to software. IBM emphasized its commitment to making quantum computing accessible by developing Qiskit, an open-source toolkit that simplified quantum computing for users. The roadmap included nurturing a community of over 290 Fortune 500 companies, academic institutions, and startups collaborating on real-world quantum computing applications. Additionally, IBM>s aim is to ensure quantum safety globally, preparing enterprises for a future where quantum computing is ubiquitous.

Session 5: Cold Atom Computing in the Kingdom, Krisztian Benyo, PASQAL



The session featured an insightful exploration into the advanced field of quantum computing using neutral atoms, led by Dr. Krisztian Benyo, a distinguished expert in guantum solutions development. The discussion centered on the innovative use of optical tweezers for trapping neutral atoms, highlighting the method's precision and scalability. Dr. Benyo presented significant achievements, including simulations of complex guantum systems up to 196 gubits, demonstrating a clear advantage in guantum computing. He also covered the application of this technology in various industries, particularly in optimizing complex network-based systems such as telecommunications. Integrating these quantum solutions into high-performance computing environments underscores the move toward applying quantum computing in practical and impactful ways.

Session 6: Future of Quantum Cryptography, Simon Patkovic, ID Quantique



ID Quantique explored how telecommunications companies could leverage quantum-safe solutions to protect enterprise data against future guantum threats, ensuring long-term data security in the quantum era. The presentation highlighted the transformative impact of quantum computing, sensing, and communications on the energy, finance, and healthcare industries, promising unprecedented advancements and opportunities. It detailed the crucial steps for transitioning to quantum-safe cryptography, emphasizing the urgency of the "hack now, decrypt later" threat and the need for immediate action to protect sensitive data. This session underscored the pivotal role of quantum technologies in shaping a secure future.

Exhibitions

As an integral component of the event, an exhibition showcasing the latest advancements in quantum technology and applications was featured to educate and inspire attendees. This exhibition brought together leading institutions and companies at the forefront of quantum innovation, including KACST, KFUPM, IBM Q, PASQAL, Quantinuum, IDQ, Infinity Q, and Quantum Brilliance. Each participant displayed unique contributions to the field, ranging from groundbreaking research and development projects to practical applications of quantum computing, sensing, and cryptography. The exhibition provided a vivid glimpse into the future possibilities of quantum technologies, facilitating a deeper understanding and appreciation among visitors while fostering discussions on potential collaborations and advancements within the sector.

These exhibitions not only educated and inspired attendees, but also fostered discussions on potential collaborations and future advancements within the quantum technology sector. Below is an overview of what each exhibitor presented:



KACST - Showcased the Quantum Cryptography Analogy Demonstration Kit, provided detailed explanations of the Counterfactual Communication Protocol, and presented flyers on quantum topics in the Arabic Language.



KFUPM - Displayed their leadership in quantum computing education and research, highlighting their undergraduate and professional master's programs and their collaboration with Aramco on quantum communication, sensing, and security research.



PASQAL - Presented their development of large-scale quantum processors using neutral atoms, aiming for over 100 qubits, with applications in optimization, drug discovery, and machine learning, highlighting their collaboration with Aramco.



Quantinuum - Featured their expertise in trapped-ion quantum computers that is a result of the merger with Honeywell's quantum hardware division with Cambridge Quantum's software expertise, focusing on drug discovery, finance, and optimization application.



IDQ - Demonstrated their advancements in data security technologies, including quantum key distribution for unbreakable encryption and quantum sensing for precise photon measurement solutions.





InfinityQ - Exhibited their development of room-temperature quantum technology solutions for complex optimization problems, such as the Traveling Salesperson Problem, showcasing their seamless integration with current computing infrastructures.



Quantum Brilliance - Displayed their innovative room-temperature diamondbased quantum computers, emphasizing the technology's compactness and scalability for solving complex problems in materials science, drug discovery, and financial modeling.



IBM Q - Demonstrated its prowess in quantum computing with the Quantum Platform, offering access to superconducting devices and simulators, and educational resources such as Qiskit. The booth featured interactive presentations on quantum advancements and practical applications, emphasizing IBM s specialized software and systems.



Activities for Students

A variety of activities designed for students were offered by King Salman Science Oasis from April 25–16. These activities were crafted to immerse students in quantum technologies through diverse experiences, ranging from historical explorations to interactive discussions.

The activities included the following:



Quantum Theater: Featured an Arabicdubbed video with a voiceover explaining quantum physics.



Quantum 32: Explored the relationship between quantum technologies and 32 key topics within the realm of Saudi Arabia's research and development national priorities, which include a) health and wellness, b) sustainability and essential needs, c) energy and industrial, and d) the economies of the future.



Quantum Lab: Two (2) companies demonstrated and highlighted the differences between classical and quantum computers for students.



Quantum Science-O: Dialogue sessions with specialists from the city, conducted in both the Arabic and English Languages, explained quantum computing concepts to students.



STEAM Education and Industrial Revolution: This exhibit delved deeply into the four industrial revolutions and showed visitors how a STEAM education is necessary for individuals and nations to flourish in the twenty-first century. This rich tapestry weaves together scientific progress, inspiration, ethics, and societal impact together.



Media Coverage

The event garnered significant attention across various media platforms, ensuring a broad dissemination of quantum technology's potential and impact. Detailed media monitoring and analysis revealed extensive coverage by prominent media outlets:

News and Social Media: The event featured in major publications including SPA, Sabq, Al-Madina, Makkah Newspaper, and more, highlighting the event's key discussions and innovations in quantum technologies.

Additionally, The event was widely distributed through social media, capturing significant attention and engagement as outlined below.



#of social media posts **124** Reach of posts **18.1 M**

The World Economic Forum platform: The event was posted on the World Economic Forum's platform and attracted great interest. More than 30 people subscribed and participated in the live stream available through the Forum's platform, which helped in the outreach to a wider global audience.

The World Quantum Day Official website: Details of the event were submitted to the WQD organization's official website, where it was listed as the first Saudi event for the day. This listing helped increase visibility and recognition for the event internationally.



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Moving Forward

This year marked the inaugural celebration of World Quantum Day in Saudi Arabia, bringing together a diverse array of experts and enthusiasts in the field. This event is hoped to be the first step toward expanding the celebration nationally on a larger scale in the coming years.

Quantum technologies are becoming a part of our everyday lives, influencing various sectors beyond science and technology. For the next year's celebration, it is envisioned that interest will span diverse sectors, including education, culture, and the arts. The aim is to see an array of activities that foster this broader engagement: from hackathons that challenge and inspire, to the development of toolkits and resources in Arabic, such as a comprehensive quantum dictionary. Additionally, efforts to embed quantum concepts in educational curricula and the creation of Arabic materials about quantum science are anticipated. Exploring the intersection of art and quantum science could further illustrate the versatile impact of these technologies.

The hope is that this year-s celebration will ignite a growing passion and curiosity for quantum technologies, setting the stage for an even more expansive and inclusive event next year. Through these efforts, World Quantum Day could become a key driver in promoting a deeper understanding and appreciation of quantum science across all segments of Saudi society.

Partners









OliverWyman







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King Fahd University of Petroleum & Minerals



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