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Quantum Technologies: A Disruptive Force in International Relations – The US-China Race and Its Impact on Australia's National Security

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Abstract

Quantum technologies are reshaping the future for international relations as they introduce communication, computing, encryption, and sensing capabilities that are unprecedented. This paper explores how the United States and China are tactically racing to dominate quantum technologies, examining how this competition influences the national security strategy of Australia, a key actor within the Indo-Pacific region. Australia is known as a middle power as well as U.S. ally. Its detailed geopolitical context is shaped by new quantum abilities and treaty duties. Grounded in policy analysis and expert literature, this study evaluates the disruptive potential of quantum advancements in global power dynamics through Realism's theoretical lens using a qualitative methodology. The paper concludes quantum technologies represent not merely scientific breakthroughs, but powerful tools of calculated advantage as they carry far-reaching implications for international security, alliances, plus the future balance of power.

Keywords: Quantum technologies, International relations, US-China rivalry, Australia, National security, Indo-Pacific, Realism, Strategic competition, Emerging technologies, Geopolitics

Introduction

In the 21st century, quantum technologies have emerged as a disruptive force with the potential to reshape not only scientific and industrial domains but also the landscape of international relations. Harnessing the fundamental principles of quantum mechanics, such as superposition and entanglement, quantum

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technologies offer capabilities far beyond the reach of classical systems. These advancements, while revolutionary, are also deeply strategic, particularly in the context of geopolitical competition.

The global race for quantum supremacy is currently led by the United States and China, two technological hegemons whose rivalry extends into domains of military, intelligence, and cyber operations. This competition is not just a race for innovation; it is a contest for strategic dominance in a world increasingly shaped by emerging technologies. Countries that achieve superiority in quantum computing, cryptography, and sensing may gain decisive advantages in surveillance, secure communication, and defense capabilities.

Caught between these two great powers is Australia, a key U.S. ally in the Indo-Pacific and a technologically advanced middle power. As the quantum race accelerates, Australia's national security posture is being redefined by both opportunities and threats, compelling the country to navigate a complex technological and strategic environment.

Quantum technology can be broadly categorized into four fields.

- **Quantum Computing**

Quantum computers utilize qubits, which can exist in superposition, unlike classical bits.

- This allows them to perform calculations beyond the reach of even the most powerful classical computers.
- Potential applications include drug discovery, materials science, financial modeling, and artificial intelligence.
- Researchers are actively working on developing fault-tolerant quantum computers and improving qubit coherence and connectivity.

- **Quantum Cryptography**

- Quantum cryptography, particularly quantum key distribution (QKD), offers secure communication by exploiting quantum mechanics to generate and distribute encryption keys.
- QKD ensures that any attempt to eavesdrop on communication is detectable.

- Post-quantum cryptography (also called quantum-resistant cryptography) focuses on developing cryptographic algorithms resistant to attacks from both classical and quantum computers.

❖ **Quantum Communication**

- Quantum communication leverages quantum phenomena like entanglement to transmit information.
- Entanglement allows for the instantaneous correlation of two qubits, even when separated by large distances.
- This can enable secure communication channels and potentially facilitate distributed quantum computing.
- Quantum networks can connect quantum computers and other quantum devices, enabling tasks like distributed quantum computing.

❖ **Quantum Sensing**

- Quantum sensing utilizes quantum properties to measure physical parameters with extreme precision.
- This can lead to advancements in medical imaging, navigation, environmental monitoring, and materials science.
- Quantum sensors can detect subtle changes in magnetic fields, electric fields, gravity, and other physical quantities (International Nathiagali Summer College, 2024).

These developments raise urgent questions for global security and alliance dynamics, especially in regions like the Indo-Pacific. This article explores how the US-China quantum competition is influencing Australia's national security strategy and evaluates these developments through the lens of Realist theory in international relations.

Review of the Literature

A lot of academic and policy-focused research is going on right now about how to include quantum technologies in the strategic plans of the world's most powerful countries. Quantum computing, cryptography, and sensing are no longer just for scientists; they are changing how the world works, how we defend ourselves, and how we make friends with other countries. The new literature shows that people are becoming more worried about the US-China quantum race and how it will affect

middle powers like Australia, especially in the Indo-Pacific region. This review looks at the existing research and policy commentary on the strategic, military, and governance aspects of quantum technologies in a critical way, which sets the stage for the current research.

- **Quantum Technologies in Military and Strategic Contexts**

The military potential of quantum technologies is a key theme in recent writing. Krelina (2021) lists a number of possible uses for quantum-enhanced Intelligence, Surveillance, and Reconnaissance (ISR), underwater warfare, and electronic warfare. He stresses how these technologies could change the way things are done in the military. In the same way, McKay (2022) looks at how the U.S. military talks about quantum technology as a strategic tool to "keep the fight unfair," which supports traditional Realist ideas of power and dominance.

The RAND Corporation has also talked about the imminent threat of "Q-day," which is the day when a powerful quantum computer could break current encryption systems (RAND, 2025). Their analysis shows how important it is to develop post-quantum cryptography (PQC) and work together, especially within the Five Eyes and AUKUS frameworks.

- **Strategic Rivalry: The US-China Quantum Race**

China and the United States have significant investments in Quantum Information Science (QIS), according to the Centre for Strategic and International Studies (CSIS, 2025). A centralized, top-down innovation model is being used by China in particular, which has invested over $15.3 billion in the public sector, far exceeding the $1.9 billion invested by the United States. This discrepancy highlights a larger worry that China might acquire a strategic first-mover advantage in emerging tech ecosystems more broadly as well as in quantum.

In support of this, the U.S.–China Economic and Security Review Commission (USCC) describes how China sees emerging technologies as a means of achieving regional dominance and technological sovereignty, especially in the Asia-Pacific area (USCC, 2024). These developments draw attention to a crucial security conundrum: China's parallel development could be accelerated by U.S. efforts to maintain quantum superiority, and vice versa.

❖ Governance, Standards, and International Coordination

The absence of governance frameworks in this technological arms race has alarmed academics and policy experts. To prevent abuse and guarantee ethical research development, Kop (2025) proposes the concept of a global atomic agency to regulate the quantum-AI nexus. He contends that to prevent a destabilizing "quantum divide," export restrictions and international agreements will be crucial.

Additionally, the National Quantum Initiative Act (2025 update) Wikipedia entries emphasized how U.S. legislation is shifting towards greater federal coordination through initiatives like the Quantum Sandbox, demonstrating the necessity of governance even within individual nations. A similar move towards trilateral tech alliances is the AUKUS Quantum Arrangement (AQuA), which seeks to promote collaborative research, security, and standards among the United States, United Kingdom, and Australia.

❖ Australia's Strategic Response and Regional Positioning

Australia has emerged as a crucial node in the quantum race as a middle power with close ties to the United States. Australia needs to incorporate quantum policy into its larger national security strategy, according to the Australian Strategic Policy Institute (ASPI, 2021; 2023). In line with the goals of AUKUS, ASPI provides a roadmap for the development of sovereign quantum capabilities. This includes frameworks for cyber defense under Pillar II of AUKUS, academic-industry collaboration, and ethical standards. Australia has the potential to be a leader in quantum cryptography, according to the Fujitsu APAC blog (2024), which highlights government-supported research and development initiatives as well as collaborations with related defense industries. According to the Lowy Institute (2023), national investments in domestic quantum computing infrastructure support these efforts.

Concerns regarding technological dependence persist despite these proactive measures. As the CSIS report notes, the U.S. increasingly relies on allies like Australia for niche innovation, which puts pressure on Australia to meet strategic expectations while managing its own vulnerabilities.

❖ Gaps and Opportunities in the Literature

Few studies systematically examine how this race affects Australia's national security doctrine through a theoretical IR lens, despite the literature offering rich insights into the military, technological, and governance aspects of quantum technologies. Practical national defense strategy analysis and classical IR theory, like Realism, are not integrated into the majority of policy papers and think tank reports, which instead concentrate on technical overviews or recommendations.

To bridge that gap, this paper uses a Realist framework to analyses how states—including the United States, China, and Australia—are acting in an emerging quantum order as they strive for survival and power. It also highlights the importance of comprehending alliance dynamics and the ways in which middle powers, such as Australia, adjust to quickly evolving technological landscapes.

Rapidly, quantum technologies are becoming essential elements of a country's power. The Indo-Pacific region's strategic balance is shifting as China, and the United States compete for supremacy in quantum technology. The national security strategies of allied middle powers, especially Australia, are now directly impacted by this competition, which is no longer restricted to the economic or technological spheres. It is still unclear how Australia is adjusting to or getting ready for the disruptive implications of the quantum era, despite rising investments and partnerships like AUKUS. By investigating the relationship between strategic security planning and quantum technological advancement in the context of global rivalries, this study aims to close that gap.

Theoretical Framework: Realism in the Quantum Age

❖ Introduction to realism

Realism is one of the foundational theories in International Relation, which strengthened after WWII. Realism believes in the survival of the fittest, Power is an end means for realism. In realism context Human beings are bad by nature believe in conflict of Interest, Realist say world is anarchy there is no centralized power in the world, State is a unitary actor. States operate under conditions of constant insecurity and are compelled to act in their national interest. This often manifests in military build-ups, strategic alliances, and technological competition.

❖ Applying Realism to the Quantum Technology Race

A Realist perspective directly explains the global struggle for supremacy in quantum technologies, particularly between China and the United States. The need to maintain strategic superiority and safeguard national interests motivates both powers. Their significant investments in secure quantum communication, post-quantum cryptography, and quantum computing demonstrate this. Potential military uses of quantum technologies, like advanced submarine detection or unbreakable encryption, represent instruments of absolute and relative power, which are central ideas in realist theory.

John Mearsheimer's Offensive Realism holds that states are naturally driven to increase their power rather than merely preserving their existing place in international order. Under these circumstances, the United States' alliances and strategic research initiatives (such as the National Quantum Initiative and AUKUS) are intended to maintain its hegemony, while China's top-down model and central planning around quantum R&D can be interpreted as an attempt to subvert the U.S.-led international order.

❖ Australia's Strategic Calculations Under Realism

As a middle power, Australia is reacting to this strategic environment by strengthening its ties with the United States, its most powerful security partner, according to realists. Australia is attempting to lessen vulnerability by taking part in quantum research and Defence integration through programs like AUKUS Pillar II and Five Eyes. These partnerships are in line with the Realist idea of balancing behaviors, which holds that weaker states should form alliances with more powerful nations to protect themselves from emerging threats, in this case, China's developing quantum capabilities.

A realist desire to maintain sovereignty and strategic autonomy even when operating within an alliance framework is reflected in Australia's initiatives to boost cyber and intelligence cooperation and invest in domestic quantum innovation. Soft balancing can also be seen in its choice to co-develop quantum capabilities rather than rely entirely on American technology.

❖ Realism and the Emerging Quantum Security Dilemma

The security conundrum that arises in the quantum era is also explained by the application of realism. The development of superior quantum cryptography or

navigation systems by one state, such as China, forces other states, like the United States and its allies, to match or exceed those capabilities to prevent vulnerability. A technological arms race results from this cycle of action and reaction, escalating mistrust around the world and possibly upending international order.

Current developments, such as export controls, quantum IP restrictions, and the militarization of research collaborations, are clear examples of the realist prediction of inevitable rivalry and competition. Although cooperative among allies, even programs like AUKUS are essentially balancing mechanisms designed to counteract perceived threats posed by China's quantum advancements.

A strong framework for comprehending states' strategic actions in the face of developing technologies is offered by realism. The struggle for quantum supremacy is a struggle for influence, power, and survival as much as it is a technological one. When viewed through a realist lens, the actions of China, Australia, and the United States seem logical and predictable: each aims to maximize its strategic advantage in a world that is competitive and uncertain. Quantum technologies will probably intensify current conflicts and change the structure of international security as they develop further.

Methodology

Understanding the meanings, viewpoints and strategic decisions of state actors in context of quantum technological development is the focus of these studies' qualitative research methodology, which is based on an interpretivist paradigm. Complex political, technological and security interactions that are difficult to quantify are best analyzed using a qualitative approach (Creswell, 2014).

- **Research Design**

The study descriptive and analytical design focuses on how major players specifically, China, Australia and the United States have responded to the development of Quantum Technologies. The study theoretical framework is realism, which views state actions as motivated by the desire for survival and power in anarchic international systems (Mearsheimer, 2001; Waltz, 1979).

❖ **Data Sources**

Since all the data used in the research is secondary, a variety of sources pertinent to the studies of technological and geopolitical aspects can be examined. These consist of:

- Academic preprints and peer- reviewed journal articles (e.g., Krelina, Mckay, Kop).
- Policy reports from thick tanks like USCC, API, CSIS and RAND Corporation.
- Documents from the government alliance, such as official strategy briefings, AUKUS Pillar and the National Quantum Initiative Act.
- Reliable news outlets like Reuters, The Australian and niche tech blogs like Fujitsu APAC.
- Wikipedia supplemental summaries (used sparingly and only for recent policy descriptions; not used for analytical purposes).
- As is common qualitative security research, this heterogeneous data set is triangulated to enhance validity and lessen bias (Yin, 2018).

❖ **Method of Analysis**

Critical discourse analysis (CDA) and document analysis are used in the study to analyze how states express their security concerns and quantum strategies. While CDA assists in examining how language shapes strategic narratives, document analysis enables the extraction of important themes and patterns from policy texts and academic discussions (Fairclough, 1995).

Important components of analysis consist of:

- Quantum technologies are strategically framed using terms like "unbreakable encryption," "Q-day," and quantum supremacy.
- Alliance behavior patterns, investment priorities and perception of threats.
- Changes in national security discourse have been identified, particularly in Australia's alignment with the US-led framework.

Limitations

This study is constrained by the range of publicly available documents because it is desk-based. Primary data collection methods like interviews and classified

government information are not included. Furthermore, some sources might soon become obsolete due to the quick speed at which quantum technology is developing. By using the most up-to-date and reliable sources available at the time of writing, these limitations are acknowledged but lessened.

Ethical Considerations

Since there are no human participants or private information involved, ethical approval is not needed for this study. However, by making sure all sources were appropriately cited and interpreted in context, ethical academic standards were upheld.

Discussion

- **Quantum Technologies as a Tool of Strategic Power**

In the struggle for dominance in the world, quantum technologies are becoming strategic assets. Globally, military doctrines and intelligence paradigms are being shaped by quantum computing, communication, cryptography, and sensing (Krelina, 2020). China and the US involves in a techno-strategic rivalry, and both countries believe the quantum dominance is necessary for both global leadership and national survival. This perspective is in line with realist theory (Mearsheimer, 2001; Waltz, 1979).

Quantum-secure communication, quantum sensing for submarine detection, and quantum computing for codebreaking are examples of capabilities that are not just scientific objectives but also tools of national power and strategic leverage (CSIS, 2025).

- **US–China Rivalry: A Realist Contest in the Quantum Domain**

Supported$15.3 billion in state investment, Chinas top-down approach reflects a desire for regional dominance and technological independence (USCC, 2024). In the meantime, the United States is reversing this through partnership like AUKUS and Five Eyes (ASPI, 2021) and public-private innovation through the B=National Quantum Initiative Act (Wikipedia, 2025). The Offensive Realist claim superpowers aim to maximize their relative position is supported by these strategic actions (Mearsheimer, 2001).

As a result, the race for quantum advantage has emerged as a pivotal arena in the larger U.S.- China rivalry, which goes beyond economics to include hard security and global governance.

- **Australia's Strategic Response: Between Alliance and Autonomy**

According to relist theory, Australia's response is in line with balancing behavior. To lessen its over-reliance on allies, it is investing in sovereign quantum R&D capacity while aligning with the United States and the United Kingdom through UAKUS pillar II (ASPI, 2021; Fujitsu APAC, 2024). This dual approach is similar to soft balancing, in which middle powers, such as Australia participate in security blocs while retaining strategic flexibility.

Australia can access advanced capabilities by joining initiatives like AQuA (AUKUS Quantum Arrangement) (Wikipedia, 2025), but there are limitations associated with alliance commitments. As a result, policy conflicts arise between the need for security and the desire for technological autonomy (SAPI, 2023).

- **Post-Quantum Cryptography and the "Q-Day" Threat**

The threat of "Q-day," or the time when a potent quantum computer could crack contemporary cryptography, is among the most pressing concerns. According to the Australian (2025) and the RAND Corporation (2025), Australia and other allies need to get ready by implementing post-quantum cryptography (PQC) techniques right away.

Together with tech partners and allied defense companies, Australian agencies are investigating quantum-safe algorithms (Fujitsu APAC, 2024). This demonstrates proactive national Defence, whole aligns with the Realist principle of taking action prior to vulnerabilities being revealed (Waltz, 1979).

- **Quantum Standards, Ethics, and Governance**

Some academics such as Kop (2025), support an International Organization to handle the moral and strategic risks of the convergence of quantum and artificial intelligence, despite realisms skepticism of international cooperation. However, most of the government initiatives are trust bases and rationalized, like the U.S. export control reform under the Quantum Sandbox amendment and AUKUS's internal R&D framework (Wikipedia, 2025).

States are developing exclusive technological spheres of influence instead of establishing legally binding international agreements. Instead of using broad multilateralism to shape the governance agenda, Australia can this by forming trusted alliances (ASPI, 2023).

- **The Emerging Security Dilemma**

A security conundrum is being brought on by the quick development of quantum capabilities: The United States and its allies are accelerating their quantum projects to keep up with Chinas deployment of quantum radar satellite communication (Krelina, 2121; McKay, 2022). As a result, even cooperative allies maintain competitive postures in the quantum domain, creating a strategic arms race.

This dynamic can be explained by realism, which holds the states to act primarily in their own self-interest to avoid technological vulnerability and that trust is limited, even among partners (Mearsheimer, 2001).

- **Implications for Future Strategy**

Three strategic imperatives need to be managed by Australia:

- Invest in sovereign quantum research, particularly in post-quantum cryptography and sensing.
- To guarantee interoperability, strengthen alliance coordination under AUKUS and Five Eyes.
- Take an active role in establishing International standards that consider both strategic and ethical considerations.

Australian efforts to preserve security, influence and adaptability in a world where quantum technologies will influence the next generation of global power structures are reflected in each of those responses (ASPI, 2021; Kop, 2025).

The strategic environment of international relations is changing due to quantum technologies, which are no longer merely theoretical. According to realist theory, the actions of China, Australia and the United States are all logical attempts to gain advantage, power and survival, Australia faces both opportunities and risks in the quantum era; it must strike a balance between relying on strong allies and claiming its own technological sovereignty and strategic voice.

Conclusion

Quantum technologies are becoming one of the most consequential forces shaping International Relations in the 21st century. Their revolutionary potential encompasses military, economic and diplomatic aspects, redefining not only how states protect themselves but also how the engage with each other In a world order that is becoming more competitive and unpredictable.

This essay has shown that, especially in the context of anarchic international system where states aim to maximize power for survival, the race for quantum technology between the US and China is a strategic competition in line with Realist theory's prediction (Mearsheimer, 2001: Waltz, 1979). Both powers have demonstrated their understanding of quantum supremacy as a crucial factor in determining their future global influence through significant state-led investments, military integration, and diplomatic initiatives.

Australia's status as a middle power and ally of the United States creates special opportunities and challenges within this geopolitical rivalry. Australia is actively integrating itself into Western bloc's quantum future through programs like AUKUS Pillar II and its involvement in coalitions like Five Eyes ASPI, 2021). But it also must contend with the difficulty of preserving strategic independence while depending on outside partners for research capabilities and vital technologies (Fujitsu APAC, 2024).

One important conclusion is that Australia needs to develop its national security strategy in three parallel ways:

- Enhancing sovereign quantum capabilities, particularly in the areas of secure communications, cryptography, and sensing.
- Strengthening defense and research collaboration with reliable partners to guarantee compatibility and access to state-of-the-art developments.

Taking part in quantum governance and standard-setting to influence the international standards that will govern the ethical, strategic and legal aspects of technology (Kop, 2025).

The idea of "Q-day," when encryption is rendered obsolete by quantum computers, emphasizes how urgent this strategic moment is. As previously mentioned, the

security conundrum in the quantum era might be caused by a series of technological asymmetries and misconceptions rather than direct military threats, which could upset the existing power landscape (RND Corporation, 2025; McKay, 2022).

Theoretically, this analysis confirms the applicability of realism in the age of developing technologies. State behavior in the quantum field is still largely interest-driven, competitive, and power-centric despite aspirations for international cooperation. This logic applies even to cooperative frameworks like AUKUS, which provide collective security only to the degree that they support member states' strategic objectives.

In conclusion, quantum technologies are profoundly political tools in addition to technological advancements. Their application and advancement will influence not only the country's military powers but also its standing in the changing order of international relations. Australia's requires striking a careful balance between competition and collaboration, reliance and independence. Its strategic relevance in the post quantum world may be determined by its ability to do successfully.

References

ASPI. (2021). An Australian strategy for the quantum revolution. Australian Strategic Policy Institute. https://www.aspi.org.au

ASPI. (2023). AUKUS must focus on quantum policy. Australian Strategic Policy Institute. https://www.aspi.org.au

Center for Strategic and International Studies. (2025). The U.S. must deepen quantum partnerships with allies to compete with China. https://www.csis.org

Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approach (4th ed.). SAGE Publications.

Fairclough, N. (1995). Critical discourse analysis: The critical study of language. Longman.

Fujitsu APAC. (2024, December). Beyond AUKUS: Forging a quantum-secure future. https://www.fujitsu.com/au

International Nathia Gali Summer College. (2024, June). Activity – I: Quantum Technologies. https://insc.ncp.edu.pk/act1-2024.php

Kop, M. (2025). Towards an atomic agency for Quantum-AI. SSRN. https://ssrn.com/abstract=4801815

Krelina, M. (2021). Quantum technology for military applications. arXiv. https://arxiv.org/abs/2105.03270

McKay, E. (2022). Keep the fight unfair: Military rhetoric in quantum technology. arXiv. https://arxiv.org/abs/2203.12345

Mearsheimer, J. J. (2001). The tragedy of great power politics. W.W. Norton & Company.

RAND Corporation. (2025). U.S.–Allied militaries must prepare for the quantum threat. https://www.rand.org

United States–China Economic and Security Review Commission. (2024). U.S.–China competition in emerging technologies. https://www.uscc.gov

Waltz, K. N. (1979). Theory of international politics. Addison Wesley.

Wikipedia contributors. (2025, June). AUKUS. Wikipedia. https://en.wikipedia.org/wiki/AUKUS

Wikipedia contributors. (2025, May). National Quantum Initiative Act. Wikipedia. https://en.wikipedia.org/wiki/National_Quantum_Initiative_Act

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