

# Information Request Response Form

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## In response to the Request

**By:** Ministry of Business, Innovation and Employment (MBIE)


**For:** Quantum Technology Discovery Process (2026)

**Date of submission:** Friday 6 March 2026

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## Section 1. About you

This is a Response by Te Whai Ao — Dodd-Walls Centre (the Respondent) to provide information.

Item	Detail
Name:	Te Whai Ao — Dodd-Walls Centre for Photonic and Quantum Technologies, Centre of Research Excellence (CoRE)  The logo for Te Whai Ao Dodd-Walls Centre features five overlapping circles in yellow, green, blue, purple, and orange. To the right of the circles, the text reads "TE WHAI AO DODD-WALLS CENTRE" in a bold, sans-serif font, with "for Photonic and Quantum Technologies" in a smaller font below it.
Trading name (if different):	
Physical address:	Level 3, Science III Building, 730 Cumberland Street, Dunedin
Postal address:	
Registered office:	
Website:	<a href="http://www.doddwalls.ac.nz">www.doddwalls.ac.nz</a>
Type of entity (legal status):	Centre of Research Excellence (CoRE)
NZBN registration number:	
Country of residence:	New Zealand
NZ GST registration number:	
Contact person:	Frédérique Vanholsbeeck
Position:	Director Te Whai Ao — Dodd-Walls Centre for photonic and quantum technologies
Phone number:	+ 64 9 923 8881
Mobile number:	
Email address:	f.vanholsbeeck@auckland.ac.nz

## Section 2. Your response

### General information about you

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1. What is your role or interest in New Zealand's quantum science, innovation and technology ecosystem?
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Te Whai Ao — Dodd-Walls Centre for Photonic and Quantum Technologies is New Zealand's centre of excellence in this field.

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2. How do you currently engage with quantum technology or quantum-adjacent capabilities? Insert an 'X' for any that apply:
    - Conducting research related to quantum science, innovation and technology
    - Developing quantum hardware, software or systems
    - Developing quantum-adjacent technologies such as sensing and materials
    - Providing quantum-related products and / or services to the market
    - Applying quantum technologies developed by others
    - Supplying components, subsystems, infrastructure, or services into quantum value chains
    - Exploring potential future applications or markets enabled by quantum capability
    - Other: [please describe]
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### Information about your research

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3. Describe your current and potential areas of research. Please note ANZSRC (Australia and New Zealand Standard Research Classification) codes, if relevant.
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Most of our work is in the physical sciences (51), but a few projects classify as engineering (40) and others as information and computing sciences (46). In the physical sciences, research ranges from 5102 – atomic, molecular and optical physics, including non-linear optics and spectroscopy, through to 5108 – quantum physics.

Not all our projects are mentioned in this RFI – just those closest to commercialisation. A full spreadsheet of all projects with ANZRC codes, TRL and time to market can be supplied upon request. Please see method used to identify these in answers to Questions 10 and 14.

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4. Detail your research group affiliations. Who are you working with (domestically and internationally)?
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## Local affiliations

These include the University of Otago, University of Auckland, Massey University, Victoria University of Wellington, University of Canterbury, Auckland University of Technologies, the MacDiarmid Institute, Paihau-Robinson Research Institute, Measurement Standards Laboratory, Earth Sciences NZ, New Zealand Institute for Bioeconomy Science, Museum of Transport and Technology (MoTAT) Auckland.

We are currently leading the formation of a quantum and photonic industry group with Tech NZ, known as the Quantum Forum. We conduct extensive industry, local and central government engagement on a regular basis.

## International affiliations – a summary

Te Whai Ao — Dodd-Walls Centre partners with researchers around the globe. Our colleagues are based at some of the world's most prestigious institutions and organisations. These include: Max Planck Institutes in Germany, NASA, the German Aerospace Centre, Singapore's Centre for Quantum Technologies, the UK's National Physical Laboratory, Japan's Science and Technology Agency, and the French National Research Agency as well as Australia's universities and centres of research excellence in photonic and quantum technologies.

## Details on international collaborations (not exhaustive)

**Korea** Korea's Advanced Institute of Science & Technology (KAIST) and Kyung Hee University, Korea Research Institute of Standards and Science, Korea University.

**Japan:** New Zealand and Japan enjoy a Strategic International Collaborative Research Program (SICORP). Together with New Zealand's Ministry of Business, Innovation and Employment, the [Japan Science and Technology Agency \(JST\)](#), supports international joint research into disaster mitigation, response and recovery in three, three-year projects.

We work with Prof. Takao Aoki of Waseda University, Tokyo. Japan is also a key partner in the Quantum Technologies Aotearoa Programme

**Australia:** Te Whai Ao — Dodd-Walls is a member of the Australian and New Zealand Optical Society (ANZOS) holding close relationships with other centres of research excellence and their host universities. These include three Australian Centres of Research Excellence: one hosted in Queensland (University of Queensland) for quantum biotechnology ([QUBIC](#)), one hosted in Melbourne ([Royal Melbourne Institute of Technology](#)) for optical microcombs, and one in hosted Canberra (Australian National University) for transformative meta-optical systems ([TMOS](#)).

Our Centre is investigating free space optical communications (FSOC) in an international collaboration with FSOC researchers at the [University of Western Australia](#), the [University of South Australia](#) and the [Australian National University](#) (ANU). Together the team is developing technologies to improve communications between spacecraft and Earth. We're also collaborating with the ANU in a separate project under the Quantum Technologies Aotearoa programme to explore early-stage quantum networking using quantum memories.

**Singapore:** In Singapore, we partner with the Centre for Quantum Technologies ([CQT](#)) and with the Centre for Optical Fibre Technology ([COFT](#)). As well as research collaboration, we partner with CQT in a number of education outreach activities, while COFT brings us fabrication facilities that are not available in NZ. These include their fibre draw tower. Singapore is also a key partner in our Quantum Technologies Aotearoa (QTA) programme. The joint project with CQT explores entangling atoms to measure magnetic

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fields.

Nanjang Technological University ([NTU](#)) offers a world-class environment for research, both in basic quantum science and in quantum technologies. We collaborate with NTU on a QTA project to develop an efficient transduction platform to convert quantum signals between frequencies for efficient communications over long distances.

**United Kingdom:** The UK is one of five partner priority countries in the Centre's Quantum Technologies Aotearoa programme. We partner with the [UK Quantum Technology Hub](#) in Computing and Simulation. Together with the [University of Warwick](#) we're improving New Zealand's space situational awareness (SSA) capability. The National Physical Laboratory ([NPL](#)) is supporting a massive seafloor cable-based sensing project expected to enhance seismic and tsunami sensing.

**United States:** Researchers from the US National Institute of Standards and Technology ([NIST](#)) are exploring the quantum optics of chip scale lasers in collaboration with our researchers under the Quantum Technologies Aotearoa (QTA) programme. The NIST also has a Quantum Economic Development Consortium or [QED-C](#).

The QTA programme includes another US/NZ project, this time with the [Joint Quantum Institute](#) (USA) and the [Quantum Materials Centre at the University of Maryland](#) to research devices for quantum computing applications.

We also work with NIST in Colorado, which has the necessary infrastructure to demonstrate a microwave → optical → microwave quantum network for the QTA transduction project. NIST's experience in optomechanical transduction techniques ensures the technology we develop is suitable for future use in quantum communications networks.

Together with a researcher from [NASA's Jet Propulsion Laboratory](#) we're investigating a scheme to detect high-frequency microwave radiation and thermal microwave radiation using nonlinear optics. A photonic radiometer would target GHz/THz frequencies for tracking atmospheric gases like ozone.

**France:** We have extensive collaboration with researchers at various [CNRS](#) (Centre National de la Recherche Scientifique, French National Research Agency) units in France.

The international research program known as WALL-IN is the collaboration between CNRS researchers from University of Burgundy (France), led by Dr Julien Fatome, and the photonics laboratory of Professors Stephane Coen, Miro Erkintalo and Associate Professor Stuart Murdoch at the University of Auckland. They're studying vectorial localized structures in nonlinear Kerr resonators and their applications, including the development of an Ising machine.

[MajuLab](#) is a joint laboratory of the French National Centre for Scientific research (CNRS), Cote d'Azur University (UCA) Sorbonne University (SU), the National University of Singapore (NUS) and Nanjang Technological University (NTU) offering a world class environment for research, both in basic quantum science and in quantum technologies.

**Germany:** Horizon Europe Associate Professor Mikkel Andersen and Associate Professor Scott Parkins partner in the Horizon Europe project Q-DYNAMO . This is in collaboration with Ulm University. Also, Professor Keith Gordon with Ulm and the Friedrich Schiller University in Jena.

Scott Parkins' focus is cavity quantum electrodynamics and semiclassical theory. He's also begun collaborating with the Humboldt University in Berlin to explore cold atoms coupled to light in optical nanofibers. Early career researcher Ofri Adiv is working with the Technical University of Munich to further

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his theoretical studies of coupled cavity QED systems and their critical behaviour.

Professor Joachim Brand studies computational tools for quantum technologies. He's been involved in a research partnership with the Max Planck Institute for Solid State Research . In a separate collaboration with Max Planck Institute for Solid State Research, Dr Freddy Lyzwa is exploring the spectroscopy of quantum materials, notably thin-film heterostructures.

The Centre has partnered with the German Academic Exchange Service (DAAD) since 2013 to study cold atoms and quantum information. With funding from the German Ministry of Education and Research, Associate Professor Jevon Longdell has partnered with the Technical University of Berlin to develop single photon sources used in quantum memories.

Professor Harald Schwefel specialises in non-linear optics and quantum optics. His topics of interest include optical resonators, optical frequency combs, quantum transduction, and ozone detection from space. He collaborates with German researchers from organisations including the Max Planck Institute for the Science of Light (MPL), Leibniz University Hannover, the University of Erlangen in Nuremberg, the Technical University of Freiberg, the Technical University of Darmstadt, and the Fraunhofer Institute for Physical Measurement Techniques (IPM) as well as the German Aerospace Centre (DLR).

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## Information about your commercial / business activities or potential

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5. Describe your quantum-related products, services, business activities, or potential.

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Our experts in the control and manipulation of single atoms are creating quantum memories for space-based quantum communications networks and we are working to link quantum computers. Our sensing expertise includes the creation of tiny, low-cost devices for environmental monitoring, biomedicine, astronomy and manufacturing.

### **Communications**

We build “quantum memories” - devices which can store and recall light in a way that preserves its precise quantum state. These have applications in secure communication, sensing and distributed quantum networks. We are also developing technologies to improve communications between spacecraft and Earth. We have created a laser-based method of transmission, relying on a free-space optical communication (FSOC) node as part of a network of optical telescopes across Australasia. We are exploring squeezed light sources for secure communications.

### **Computing**

Some quantum computing platforms use microwave photons as quantum information. These operate at extremely cold temperatures. Our team converts these photons into the optical domain where optical fibre works at room temperature. The team expects to reach high enough efficiency, to make the quantum internet a reality. In a separate project, we're exploring the use of Ising machines to solve

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problems faster than a classical computer can. Rooted in quantum mechanics, Ising machines can swiftly provide the optimal solution to certain problems.

### Sensing

Optical micro-resonators or microcombs are highly precise measurement tools to survey, map and measure. We're trying to make them as small and efficient as possible, even to integrate them with a laser on a single chip for mass production. Sensors are also used for space-based environmental monitoring, high precision processes in electronics and micro-optical device manufacture. Making them smaller also makes them less expensive.

We combine sensing and imaging to create bespoke technology solutions for health, agriculture, horticulture and the manufacturing sectors. They can provide minimally invasive diagnosis and precision treatment.

We are also investigating how lasers and sensors operate when subjected to extreme radiation and temperatures. This work could find application in major commercial clean-tech industries such as fusion energy systems, clean aviation, power generation and space exploration.

**Important Note:** Quantum technologies are still uncertain and in their infancy, whilst photonic technologies are already here and there are a lot of budding activities to commercialize our photonic research. **Effort is needed to ensure that "photonic technologies" are part of this platform.**

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6. Describe the maturity and commercialisation of your quantum-related research, including:

- your organisation's experience with commercialising quantum technology research;
- current technology readiness levels (TRLs);
- pathways and anticipated timeframes to commercialisation.

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### Commercialisation Experience

Our Centre has a proud tradition of commercialisation success. Last year Quantifi Photonics was sold to NASDAQ listed Teradyne. Until 2020, Quantifi was known as Coherent Solutions, itself spun out of Southern Photonics, a company built upon cutting-edge photonics research developed at the University of Auckland. Southern Photonics was founded by Professor John Harvey, one of the instigators of Te Whai Ao — Dodd-Walls Centre for Photonic and Quantum Technologies.

Southern Photonics has recently established two new daughter companies which are poised to exploit quantum technologies and quantum adjacent technologies:

(i) **Southern Sensing**- a company exploiting photonic and quantum technologies for sensing. The latest engagement of this company is in the development of temperature monitoring equipment for superconducting temperatures in collaboration with **Robinson Research Institute** and **Open Star**.

(ii) **Southern Fibre Lasers** - a company developing new optical fibre-based laser systems for industry. This company has identified a significant market opportunity for the sale of specialist laser equipment used in quantum technologies and by the large number of research institutes focusing on quantum technologies worldwide.

Te Whai Ao — Dodd-Walls Centre has supported three other high-profile university spin-out companies from the Photon Factory at the University of Auckland:

- sperm-sorting technology company, **Engender Technologies**;
- point-of-care diagnostics platform, **Orbis Technologies** and
- skin cancer screening company **Luminoma**

There are three new spin-outs in addition:

- **Probentis**, a prostate cancer detection company has been formed around technology enabling in vivo, real-time, prostate cancer diagnosis and improved surgery outcomes. This is in its clinical trial stages and being run by Claude Augergeray.

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- **Whitika Ltd** has been formed by Professor Harald Schwefel and Mahi Paurini, together with Dr Florian Sedlmeir and Dr Mallika Suresh to enabling quantum networking through microwave-to-optical transduction.

**Some additional patents in the last 3 years:** Materials for new photovoltaic cells have been patented. Now facing the issue of funding to scale. Patented novel designs are held for novel fibre lasers. Again, the reason for delay since patent is the funding for infrastructure to scale. A patent is in preparation for optical microcombs. Note: not all patents are linked to spin-outs.

## **Maturity - Technology Readiness levels**

**Method:** Researchers were asked to assess the TRL of their projects using the accepted scale. They were also asked to consider years to market. Projects with the highest TRL and closest timing to market were selected as being most ready to commercialise (i.e. Projects from TRL 4-9 and no more than 3-5 yrs to market). At Q14 we identify projects at TRL1-4 which are ready for early-stage investment and expect to be in market in 3-5 years.

Our three main fields of research are quantum sensing, communications and computing. The IP, potential products and services we have with highest TRL and closest time to market are:

### **1. Sensing.**

#### **a.) Sensing for extreme environments.**

**Optical Fiber Sensors for Extreme Environments of Temperature and Radiation.** Integrating seismic and electromagnetic waves to reveal the Moon's hidden ice. (TRL 6 est 1-2 yrs to market)

**Photobleaching as a radiation damage mitigation technique** for optical fibre sensors in extreme environments. (TRL 5 est 1-2 yrs to market)

**A compact radiation hardened photonic sensing system for superconducting fusion magnets.** Optical fibre sensors operating at cryogenic temperatures are the heart of superconducting technology. Hardware and software. Used to learn about the behaviour of these magnets as they quench (suddenly lose superconductivity). There is a large gap in the sensing technology required for commercial fusion. Robust photonic sensors are great candidates. (TRL 5, est 3-5yrs to market)

#### **b.) Sensing for agriculture**

Use of tiny lasers at beehives to zap the parasitic varroa mite. Multi-modal sample analysis. A patent application is in the commercial due diligence phase. Following a biosecurity breach in 2000 the varroa mite incursion was estimated by MAF as being likely to cost the country \$400 - \$900 million. (TRL 6 est 3-5yrs to market)

### **2. Quantum Communications**

**a.) Lasers.** The design and building of novel mode locked fibre lasers for quantum optics. Applications for these lasers include single-photon generation, squeezed-light sources and quantum cryptography. (TRL4, 1-2 years to market. Note some already being sold through Southern Photonics.)

**b.) Quantum-enabled radiofrequency electrometry and quantum-controlled light transmission.** For use in quantum field sensing and communications (TRL 5, 3-5 years to market). Essentially a next-generation electromagnetic field measurement platform for ultra-high frequencies, with major impact in telecommunications, defence, automotive, aerospace, and metrology.

### **3. Quantum computing**

**Quantum metrology and random number generation - standard setting.** Quantum electrical metrology harnesses quantum phenomena to realize precise electrical units like voltage, resistance, and current. Key effects include single-electron tunnelling (SET) for quantized charge transport, the Josephson effect for voltage standards, and the quantum Hall effect (QHE) for resistance standards. We are testing quantum

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random number generators (QRNG) giving NZ and the world a way of certifying QRNG. Some QRNGs are already available on the market, while others are still under development. **(TRL8, 3-5yrs to market)**

### **High TRL Projects coming to market later:**

**Sensing for environmental and hazard monitoring** Technology for improving earthquake and tsunami detection capabilities in the Southwest Pacific has completed proof of concept. Now developing advanced signal monitoring. Not for NZ commercial use. While the data is being collected and used by GNS, the IP is resident in UK. **(TRL 7, 5+ years to market)**

**Sensing for health** Probenitis undertakes Multi-modal sample analysis. World-leading technology for a high-demand clinical issue, prostate cancer with global market opportunity. Health-related technologies take a long time to get to market due to clinical trials. **(TRL6. Est. 10 years to market)**

### **Pathways and Timeframes to Commercialisation**

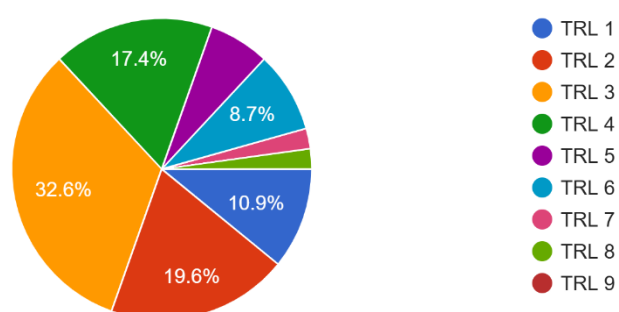
See above for particular projects.

Given the experience of Australia where these technologies are already being adopted, we consider our **sensing technologies to be closest to market**, with communications and computing available thereafter. Our monitoring projects in the extreme environments of space are the closest to market.

Positioning, navigation and timing are part of the sensing group of technologies, and they are the basis of many defence and security applications. This market need will be a driver for uptake and therefore funding and research acceleration. Sensing is also critical to maintenance of New Zealand's infrastructure networks, for which there is also significant demand, described in New Zealand's recently released 30-year infrastructure plan.

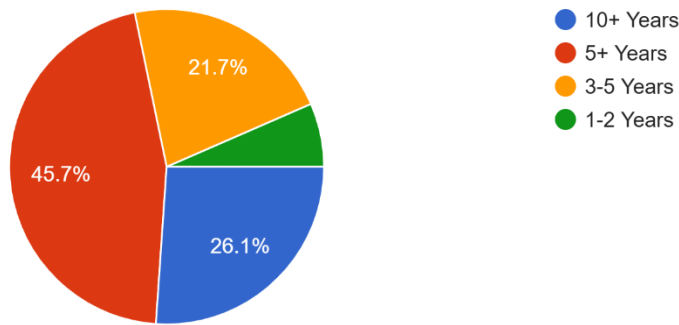
New Zealand's space expertise provides us a global market advantage from which to leverage our unique **quantum communications technologies** such as quantum memories. It also supports the development of fusion energy systems.

**In computing**, our researchers are focusing on near-term commercial opportunities, specifically the use of hybrid technologies for optimisation, such as the Ising machine; methods of connecting classical and quantum systems; as well as the quantum internet required to make everything work.



### **Translation readiness levels of our projects (n= 46)**

Most of our projects are at TRL 3, with a strong pipeline of projects in total. Just over 50% of projects are either TRL 2 or 3. This makes them heavily dependent on infrastructure facilities to develop them further. 23% are expected to be ready for market in 3-5 years and 41% in 5 or more years.



### Time to market of our projects (n= 46)

7. What is your current or anticipated commercial model related to quantum technology (e.g. IP licensing, product sales, services, export of components, contracts, grant, spin-outs)?

As a Centre of Research Excellence (CoRE), our current funding model is primarily research-driven, with approximately 55% of income derived from Vote Science and Innovation contestable funding—particularly Marsden Fund grants—and 44% from the Tertiary Education Commission CoRE Fund.

In parallel with this grant base, our anticipated commercial model in quantum technology centres on IP generation, licensing, and spin-out creation. While we do not currently generate direct revenue from spin-outs, we play a pivotal enabling the creation of future quantum IP, developing it to commercial readiness, and enabling new venture formation. We work closely with university Technology Transfer Offices (TTOs), which manage patenting and licensing processes and recoup a share of downstream revenues.

A core strength of the Centre is its ability to incubate start-ups emerging from quantum research & quantum-enabling technologies, supporting founders with technical validation, early-stage development, and helping them reach investor readiness.

Although we are not a commercial entity, we are a critical engine of commercially relevant IP and venture formation within New Zealand’s quantum ecosystem. Our commercialisation model is designed to convert publicly funded research into scalable commercial outcomes, while leveraging TTO expertise to maximise impact and return. Accordingly, we are concerned that the closure of several contestable funding streams may constrain our operational capacity in the near term.

8. Which markets or customer segments do you see as the primary opportunity for your quantum-related research, products or services? (e.g. health, energy, space, telecommunications, defence)

Key customer segments are:

- quantum computing companies defence,
- infrastructure (including telecommunications),
- space,
- finance,
- energy,
- health,
- agriculture.

These are all in need of sensing, optimisation, computing and simulation, as well as security.

## Opportunities and barriers

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9. What, if anything, distinguishes New Zealand-based researchers and firms from other participants in the global quantum technology market?
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### **New Zealand's Global Market Advantages:**

We have internationally recognised researchers who excel in their fields. Our researchers' skills range from theoretical science to translation for commercial use. The collaboration between them aids the understanding of key aspects of quantum photonics and enhances our outcomes. Their key areas of expertise lie in sensing, communications and computing.

They are sought-after collaborators. For example, we have **world-leading expertise in the physics of driven nonlinear optical resonators (sensors)**, which has drawn international participants to seek our expertise and help. Another example is our **track record in photonic sensing systems for superconducting fusion magnets**. We are working closely with two international fusion companies, both world leaders in their respective areas.

The **microwave to optical converter** is key enabling technology for scaling super conducting qubit based quantum computers beyond their current limits. **We are world leaders in the field of quantum memories for communication**. Our research has been generally about improving the performance of memories, but that performance is now at a level to make deployment out of the lab compelling.

We have a growing space sector. The **local expertise in adaptive optics (for FSO)** is world-leading in this area.

NZ has a disproportionately high number of researchers and start-up in the Medtech sector. This is an expanding field for NZ, with a very high level of expertise and innovative ideas. NZ researchers are very good at connecting with end-users (especially Māori and Pasifika) and clinicians despite the difficulty in doing so. Strong ecosystem already existing.

The agile regulatory environment permits rapid innovation.

We are recognised for high environmental standards and the provenance of organic or non-GMO high-quality produce. Our photonic technologies provide this assurance.

Proximity to Antarctica for experiments in cold and harsh environments.

New Zealand's geography, location, and seismic activity can be an advantage in several ways:

- unique remote oceanic environment with long-haul commercial fibre communication links enables testing new advanced warning technologies for other tsunami-prone regions. Niche as a global hub for high-precision metrological sensing applications that can be integrated into the existing undersea cable infrastructure of any vulnerable coastal nation.
- quantum sensing for geological applications (e.g. gravimetry, magnetometry)
- access to southern hemisphere skies for space applications (e.g. satellite communications for QKD). See space above.

Expertise in cooling, this engineering skill provides a backbone for our work. Cryogenics is considered a foundational enabler of quantum technologies, enabling them to scale.

Small country makes it easier to work in a multi-disciplinary team. These have been facilitated by CoREs and National Science Challenges. Our proximity to one another means ecosystems are readily formed, providing a solid base from which to spin out. We have a NZ-inc mindset.

Quantum technology arises from a solid and wide foundation comprising a variety of interdisciplinarity between physics, chemistry, math, computer science and engineering. The interdisciplinary research mindset remains a strength and potential for New Zealand to position itself in global quantum value chains.

NZ has access to Horizon Europe and other international collaboration and funding sources, which some competitors (e.g. Australia) don't.

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10. Where do you see New Zealand having the best chance to position itself in global quantum value chains? Are there any gaps or niches that New Zealand could fill?

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**Considering both quantum and photonic technologies:**

As a partner providing foundational support and auxiliary (niche) hardware to bigger players. New Zealand is world-famous for its know-how in quantum and photonics, and making this know-how available to other participants can serve us well. Photonic technologies are likely to be closer to market than quantum technologies. We should look to the photonic implementation of quantum technologies at the outset.

**Quantum and Photonic Technologies Supply Chain**

- Micro-resonators/frequency combs for sensing
- Photonics integrated circuits and micro-fabrication skills and IP.
- Magnets and field sensing instruments. Small device, measurement and instrumentation companies including using Kerr frequency combs.
- Quantum memories for communications. NZ-based component suppliers contributing to quantum information systems.
- Quantum networking software is a business opportunity, linked to the creation of data centres.
- Frequency converters (optical modems) for sensing and communications and computing. Microwave to optical converters are a key enabling technology for scaling super conducting qubit-based quantum computers.
- Novel mode-locked lasers. We have the know-how, patented designs and are already selling to Southern Photonics.
- Numerical and computational modelling for optimization, for example the Ising machine.

Examples of existing companies in the photonic and quantum supply chain which can support our work:

- [ETECH](#) who now supply Openstar Technologies with [vacuum cryogenic systems](#).
- Fabrum and others in the supply chain for the space industry can support quantum technologies. Fabrum has cryocoolers operating in the 20–60 K range align with emerging quantum sensing and superconducting platforms. Interest expressed in exploring quantum applications.

**Sensing Technologies**

With quantum sensing, there is scope for NZ to develop and commercialise complete systems rather than components. Positioning, navigation and timing are part of the sensing group of technologies and they're the basis of many defence and security applications. They are also in use in infrastructure and finance. NZ Defence Force is seeking mature quantum timing solutions for their new tech accelerator programme. High TRL solutions are particularly relevant.

We have world-leading expertise in "microresonator optical frequency combs" or "microcombs", a precision measurement technology with massive potential. COMBS are poised to drive a giant leap forward in many applications, from telecommunications to sensing and the internet. A patent application is being prepared.

Nonlinear phase-locking for ultrashort light generation. Ultrashort pulses of light underpin numerous applications, ranging from micromachining and eye surgery to precision metrology and spectroscopy.

Spectroscopy and imaging for numerous health applications e.g. cochlear applications, sperm sorting, cancerous cell detection and non-communicable diseases (e.g. age-related).

Photonic sensing technology for improving earthquake and tsunami detection capabilities in the

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Southwest Pacific has completed proof of concept. Now developing advanced signal monitoring. (TRL7. Note: All IP is UK)

Excellence in environmental monitoring from space. Optical fibre sensors for extreme environments of temperature and radiation. This system will be unique to the world, combining laser-based cryogenic and vacuum technologies to test planetary materials at lunar conditions.

Quantum sensing in agriculture. There's a healthy spectroscopy environment. e.g. Agnition Ventures & Ravensdown: Exploring quantum sensing (gravimetry, magnetometry) to enhance precision agriculture. Potential for NPL to support sensor development and integration with ML/digital twin models.

### **Communications Technologies**

We are better positioned to develop quantum communications building blocks than complete quantum communications systems.

New Zealand's space expertise provides us a global market advantage from which to leverage our unique quantum communications technologies. These include: quantum memories, Photonic-Integrated-Chip-based scalable repeaters for early-stage quantum networking and Free Space Optical Communication. Our space sector also supports the development of fusion energy systems.

The design and building of novel mode-locked fibre lasers for quantum optics applications. These include single photon generation, squeezed light sources and quantum cryptography.

### **Computing Technologies**

In computing, our researchers are focusing on near-term commercial opportunities, specifically the use of hybrid technologies for optimisation, the Ising machine; methods of connecting classical and quantum systems, as well as the quantum internet required to make everything work outside a cryogenic environment.

Microwave to optical transduction is being used to convert microwave signals to photons to connect systems and classical and quantum technologies.

Quantum computing security technologies such as Post-Quantum Cryptography and Quantum Key Distribution.

### **Evidence of NZ customer need arising from Quantum Meets engagement 2025.**

- Predictive modelling in infrastructure
- Defence – seeking mature quantum timing solutions for their new tech accelerator programme. Miniaturization.
- Agriculture, health and environmental monitoring companies seeking to access time on a quantum computer for optimisation, problem simulation
- Post quantum security.

Must match technology readiness (TRL) with **ARL (Adoption Readiness Level)**: Assesses commercialization, market adoption, and user acceptance risk.

**MRL (Manufacturing Readiness Level)** : Evaluates readiness for production, including capability, quality control, and supply chain.

TRL ensures the technology works, ARL ensures a market exists, and MRL ensures it can be produced reliably. These frameworks are often used together to manage the transition from research to commercial deployment, with **MRL typically starting around TRL 3-4.**

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**N.B. Given the number of DWC projects at TRL 3-4 research infrastructure will be more important than anything.**

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11. From a research perspective, which of the following are the most significant barriers or bottlenecks to expanding research and commercialisation of quantum technologies? Rank the following (give a score of 1 to 6, with 1 being most significant) and provide an explanation:

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\_2\_ Talent and workforce capability

\_1\_ Infrastructure and equipment

\_4\_ Regulatory requirements (e.g. approvals, licences, specific rules) or uncertainty

\_3\_ Early-stage investment funding

\_\_\_ Cultural or practical factors in the New Zealand context

\_5\_ Other: Time

1. Infrastructure. Improved fabrication facilities and access to hardware and software prototyping facilities. The infrastructure needed should be several and institution-based, so that researchers can have long-term, close access to fabrication facilities through the prototyping cycle, not just “drop in” services. Consider two nodes in NZ as part of the Australian National Fabrication Facility (ANFF). Infrastructure is also needed to retain and attract talent.
2. Skills. New Zealand regularly loses the scientists it trains to offshore. Students travel for wider experience in larger markets and because they can’t find work in New Zealand. It’s a chicken and egg problem.

While our academics are excellent, NZ needs a different type of workforce capability. It should be interdisciplinary, one where experts in physics also have skills in engineering, mathematics and the creation of algorithms. We especially need photonics engineers who understand light, fibre and optical components. They could be PhD students in photonics working on applied projects, but Master’s would be sufficient. Engineering training should be cognisant of the demand for quantum engineers.

If we are to develop industries/companies around these technologies, we need to be able to retain these skilled workers. This could be through salaries and other incentives. In France, a company that hires a PhD for research and development has the first year’s salary subsidised by government.

Skills in entrepreneurship would be an additional advantage. Also the ability to relate across cultures to capture the burgeoning opportunities in the Māori economy.

3. Funding. Lack of early-stage venture support, diversity of funding (public or private). Grant funding for projects at all stages of technology transfer readiness is a positive way of providing the market with greater confidence.
4. Regulation/policy. There’s uncertainty in the market while the science system reforms are underway.

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12. What types of new businesses or spin-outs could emerge if the right research and infrastructure were available in New Zealand?

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Sensing devices and communications for defence purposes, including novel mode-locked fibre lasers for quantum optics. Single photon generation squeezed light sources for quantum cryptography. Ring laser for inertial navigation in aircraft, missiles, ships, and spacecraft.

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Improved sensing devices for infrastructure, especially using magnets and field sensing.  
Improved sensing devices for health, leading to the creation of new medtech companies  
Improved sensing devices for agriculture (including those which kill varroa mites)  
The creation of new, low cost, better climate monitoring devices.  
Hybrid quantum computers and interconnectivity to a new “internet”  
Secure communications in space  
Quantum memory and data storage

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13. What has prevented these opportunities from being pursued to date?

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Capital cost of infrastructure, funding including early-stage venture support, diversity of funding (public or private and skills).

We require microfabrication facilities at universities to develop optical integrated circuits. We want to leverage what we have, and integrate with Australia where appropriate (ANFF).

<https://reconnected.org.au/case-studies/the-unseen-engine/> demonstrates the importance of Australia’s institute-based interconnected research infrastructure.

**Note:** At least three patented technologies within our centre lack the fabrication facilities to demonstrate their device can operate at scale. These are: lasers, quantum transducers, and photo-voltaic cells.

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14. How do you perceive the availability and attractiveness of early-stage investment opportunities in quantum technology?

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**Considering both quantum and photonic technologies.** Early-stage investment is considered to be TRL1-4. Most of our projects are at TRL 3, with a strong pipeline of projects in total. Just over 50% of projects are either TRL 2 or 3. This makes them heavily dependent on infrastructure facilities to develop them further. 22% are expected to be ready for market in 3-5 years and 46% in 5 or more years.

In short, there are plenty of opportunities but barriers such as infrastructure, lack of early-stage venture support, diversity of funding (public or private), etc get in the way.

**The most promising products and services we have for early-stage investment (eg TRL 1-4) are:**

#### **Sensing**

**Agricultural, Forestry and other field sensors at scale.** Noncontacting, non-destructive testing from lab to field scale, ring laser sensing for subsurface characterization. Can deliver at scale, need testing in the field. Note that Māori enterprises are willing participants in such projects. **(TRL 4, 3-5 years to market.)**

**Machine/deep learning and AI in quantum systems.** Multi-modal sample analysis. Leverage machine/deep learning to better characterise quantum systems and to better interpret signals returned from appropriate sensing devices. **(TRL 4, 3-5 years to market).**

**Advanced fiber optic sensing technologies.** Optical fibre sensors for extreme environments of temperature and radiation. The development of radiation-hard, cryogenically compatible sensors is necessary for advanced space and fusion applications. **(TRL 4, 3-5yrs to market)**

**New class of highly sensitive quantum microcomb (sensor).** Quantum (and classical) optics of parametrically driven microcombs. **(TRL 4, time to market 3-5 years)**

#### **Computing**

**Hybrid computer.** A new type of optical Ising machine that can solve complex (NP-hard) combinatorial optimization problems. **(TRL 4, time to market 3-5 years)**

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## **Communications**

**Quantum memories.** Developing scalable quantum repeater technologies using rare earth minerals. We have made foundational contributions to quantum memories for light using photon echoes and rare-earth ion dopants. The performance of memories is now at a level to make deployment out of the lab compelling. **(TRL 4, 3-5 yrs to market).**

**Quantum transducer for microwave to optical conversion.** **(TRL 4, 3-5 yrs to market)**, subject to investment in infrastructure. We want to transfer an electrically driven single microwave photon source into the telecom domain with our electro-optic whispering gallery mode resonators. This would provide an on-demand telecom signal photon source that is a key component in quantum networks and photonic quantum computing.

They would be more attractive if de-risked with partial Government funding and had prototyping and other infrastructure to develop technology at scale.

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15. From a business perspective, which of the following are the most significant barriers to getting New Zealand quantum-related products and services to domestic and international markets? Rank the following (give a score of 1 to 8, with 1 being most significant) and provide an explanation:
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- 1\_ Access to specialised infrastructure or facilities
- 2\_ Ability to attract and retain globally competitive talent
- 3\_ Availability of patient growth capital
- 5\_ Difficulty securing early customers or reference clients
- 4\_ Small domestic market
- 6\_ Fragmentation between research and industry
- 7\_ Regulatory or export control uncertainty
- Other: [please describe]

We don't have a specialist degree in quantum and photonic technologies which covers industry needs.

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## **Designing an effective national research platform**

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16. What specific areas of quantum technology (enabled and / or adjacent) should a national research platform focus on to maximise economic benefits to New Zealand?
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### **Photonic and quantum sensing**

- Non-linear optics, microcombs/micro-resonators
- Environmental monitoring, on earth, under the oceans, in and from space.
- Photonic sensing for MedTech and health, infrastructure, defence and agriculture.
- Quantum sensing using atoms.

### **Communications**

- Quantum networking, memories, and repeaters.
- Lasers and non-classical light sources for quantum optics, telecommunications.

### **Computing**

- Hybrid hardware models
  - Quantum software.
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- Applications enabling connectivity between systems and states (such as microwave to optical transduction)
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17. What barriers (identified earlier) could be addressed through a national quantum technology research platform, and which may sit outside its scope?

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All barriers except the domestic market size and our geographic isolation could be addressed by a new platform. A platform would be the natural precursor for an ecosystem linking industry and research.

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18. What core functions and operating models could help a platform support rapid progress towards commercial outcomes?

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An interdisciplinary translation centre. See [Waterloo University's model](#).

- 1) The platform needs to have a structure that enables many groups to interact, not duplicate existing structures adding administrative costs.
- 2) The platform needs to support with funding of research and infrastructure/ creating inventory. Food Innovation Network has a good model of interconnected nodes.
- 3) The model does not need to replicate what the government funds already
  - o Does need a strategy which is created by creators and users in NZ, not consultants
  - o Engage with key stakeholders who do activation events (eg TechNZ)
  - o Engage with key stakeholders who do commercialisation (TTO)
  - o Engage with key stakeholders who do commercialisation training (Kiwinet)

Consider the role of the CoRE in relation to the new Platform. We expect that ongoing, CoREs may manage research projects at TRL 1-4, with a clear pathway to commercialisation provided by a new platform for projects at TRL 5-9.

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19. Are there international models or partnerships we should consider adopting?

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Start with a strategy or at least a plan.

Singapore's The National Quantum Office (NQO) is a national platform that was established with the support of the National Research Foundation (NRF) to drive the development and implementation of the National Quantum Strategy in Singapore. The Office was set up in April 2022 and is hosted by A\*STAR, the Implementing Agency for Quantum. A key focus of the strategy is to strengthen scientific excellence in high-impact areas of quantum research, such as quantum communications, security, processors, and sensing. Leaders in computing and processing.

UK Quantum Hubs linked back to missions in areas where they have traditional strengths or a point of difference.

Stronger relationships with Australian COE's where there's often an overlap of Kiwi-trained personnel. These organisations are largely grant-funded. Australia's quantum ecosystem has been boosted by opportunities through the country's National Reconstruction Fund.

Several states in Australia have linked or competing quantum-related infrastructures or network to bring research to commercial products. Enabling better connections and partnering with these states. We are already working on this.

Consider inviting a quantum computing company to host a computer in NZ (arguing strategic national security etc). We note that Singapore and Australia both host such companies. Enable time on this to

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train talent, conduct research, as well enabling industry access.

Safeguarding sovereign capability and resilience.

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20. What collaboration models have worked well for your organisation in the past (and what hasn't)?

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Particularly strong relationships with Australia through their quantum and photonic related centres of excellence. Professional organisations such as Australia New Zealand Optical Society (ANZOS) and student chapter consortium, KOALA.

Also NIST, DLR, CNRS, Singapore.

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21. What would make a platform genuinely attractive for your organisation or firm to engage with? What would discourage your participation in a national platform?

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**An Attractive Platform:**

**Best-in-class** research platform drawing on lessons from the world's strongest translational ecosystems.

**Virtual and mission led**, capability-based national system, it does this by combining scientific excellence, training and producing talent, high-performance infrastructure, tight industry-academic collaboration. Must enable researchers from around the country to collaborate. Must incorporate a commitment to Māori partnership.

**One coordinated operating model** rather than running isolated projects. Must range TRLs and provide an evident pipeline. Must provide and support clear pathways to commercialisation.

**Policy-aligned** with the Government's Economic Growth Pillars. Supported and championed by the government, industry including Māori enterprises. In strong collaboration with Australian state ecosystems.

**Funded** – A well-funded platform in pursuit of excellence. Need to enable ecosystem activations, e.g. events, workshops, international delegations. An example is the Fraunhofer-Gesellschaft Institutes, which have a model providing five years of secure funding for researchers rather than year-on-year contracts.

**Connecting** - innovators, clinicians, researchers, investors, venture capitalists and industry from NZ as well as our overseas collaborators. A place with open doors to industry so that partners and collaborators of all cultures, especially Māori, could visit.

**Coordinating national capability and resources** - It would be underpinned by several institutionally based in-house prototyping and design facilities from hardware to software and devices. A platform where key disciplines could work together seamlessly, with access to engineering and skills in writing algorithms. MedTech IQ is a good example of a national innovation hub, with physical regional hubs

**A Discouraging Platform:**

One with a limited singular focus. No or limited hard-to-reach new infrastructure to fabricate or prototype. A platform that did not encourage fundamental science or researchers to move their research through stages of translation readiness. Cut off from industry, without associated infrastructure or funding.

Produced by policy with no engagement with researchers, industry, Māori or Pasifika.

One that spends funding/resource on setting up an administrative structure rather than a coordinated network enjoying what attributes are already existing.

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22. Are there international partners or ecosystems that New Zealand firms should align with to accelerate commercial outcomes?

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We should be partnering more closely with Australia:

Both face similar challenges, small population, limited domestic capital, and needing to stay internationally competitive.

Australia is already determining quantum customer need and driving quantum technology adoption.

There are pre-existing trans-Tasman quantum innovation networks, joint centres of excellence, student exchanges, joint PhD programmes. A number of trans-Tasman professional societies such as ANZOS already existing.

Shared use of specialised infrastructure.

Strengthen the collaboration with already named institutions in South Korea, Australia, United States, Germany, France, Japan, United Kingdom.

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## Anything else?

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23. Looking ahead 10 years, what would success look like for New Zealand's quantum technology sector from your perspective?

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Quantum and photonic technologies are embedded in national priorities as an enabler (national security, economic resilience, environmental stewardship, and regional development)

New Zealanders (general public) have a basic understanding of the tech, are curious not fearful of it, there is early adoption and a growing industry of makers.

Coordinated ecosystem not just pockets of greatness including companies of all sizes. A healthy ecosystem where mature spin-outs mentor recent ones.

Steady flow of graduates trained in quantum engineering, photonics, materials science, and quantum software. Māori and Pasifika participation in the sector, supported by culturally grounded STEM pathways.

Attraction and retention of global talent through competitive research environments, industry opportunities and stable research funding.

Success would look like at least six more spin-outs, a pipeline of more to come, global recognition for New Zealand's sensing, computing and communications technologies.

That NZ will have attracted leading talent and investment in our fields of economic advantage.

There's well-used infrastructure in place, which is cost-neutral.

There are strong relationships with industry and Māori enterprises. Sensing technologies have been adopted across multiple sectors, but especially in defence, infrastructure and agriculture.

Communications technologies are moving into market along with computing.

We have interdisciplinary researchers and sufficient skills in photonics engineering and algorithm writing. Our researchers have improved commercialisation skills.

One or more quantum hubs is offering its infrastructure and expertise to start-ups, including in a Māori context.

Multi-sector, multi-site collaborations are growing.

We are exporting quantum/photonic communications components and full sensing systems across multiple industries.

Strong international partnerships continue, especially with Australia. Indigenous partnerships for capability building and niche commercial opportunities.

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24. Is there anything else you would like to share that would help inform this Discovery Process?

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The issue is that we don't have a lot of companies using quantum technologies, and they lack the understanding of how they can use it. Quantum curiosity is only just being ignited here. NZ is behind the rest of the world, so we can learn how Australia has started building their ecosystem (including identifying and responding to customer needs across sectors, driving adoption and uptake), and take key actions from them.

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## Section 3. Respondent's declaration

Topic	Declaration	Respondent's declaration
<b>Information Request Terms:</b>	I/we have read and fully understand this Information Request, including the Terms. I/we confirm that the Respondent agrees to be bound by them.	[agree]
<b>Conflict of Interest declaration:</b>	The Respondent warrants that it has no actual, potential or perceived Conflict of Interest in submitting this Response.	[disagree]
<b>Details of conflict of interest:</b>	[We submit this on behalf of a centre that will directly benefit from the establishment of a quantum hub].	

### DECLARATION BY THE RESPONDENT

I/we declare that in submitting the Response and this declaration:

- the information provided is true, accurate and complete and not misleading in any material respect
- the Response does not contain any material that will infringe a third party's intellectual property rights
- I/we have secured all appropriate authorisations to submit this Response, and to make the statements and to provide the information in the Response.

By signing this declaration the signatory below represents, warrants and agrees that they have been authorised by the Respondent to make this declaration on its/their behalf.

Signature:



**Full name:** Frédérique Vanholsbeeck

**Title/position:** Director Te Whai Ao — Dodd-Walls Centre for photonic and quantum technologies

**Name of organisation:** Te Whai Ao — Dodd-Walls Centre for Photonic and Quantum Technologies, Centre of Research Excellence (CoRE)

**Date:** 06/03/2026