The new wave of Photonic and Quantum Technologies

Quantum Meets Health

Frédérique Vanholsbeeck, Director

Te Whai Ao
Dodd-Walls Centre
for Photonic and Quantum Technologies

Outline

- What are quantum technologies and why are they revolutionary?
- Why are quantum technologies important?
- How can the technologies help my business?
- Risks and opportunities for NZ
- What should businesses do?

Credit: Paul Sutherland Photography
https://toolkit.nzstory.govt.nz/assets/213134?tags=Image,Services

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What is quantum tech. & why is it revolutionary?

1st Generation:

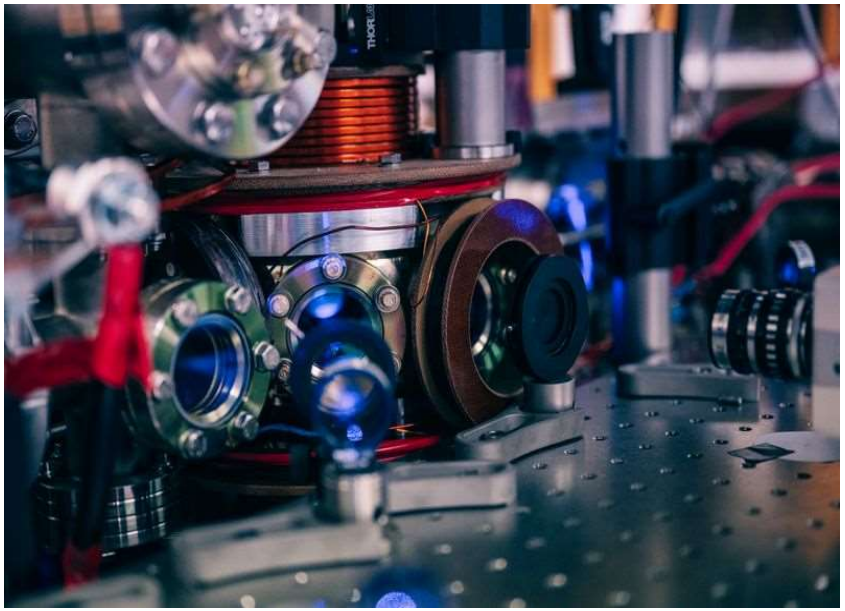
Quantum mechanics and silicon led to the development of semiconductors, transistors, lasers, computers & internet.

2nd Generation:

Underpinned by quantum properties of entanglement & superposition. Photonic and quantum technologies overlap because light particles are one of the most powerful carriers of quantum information. Applications in:

- Computation
- Communication
- Sensing (positioning), timing and navigation
- Simulation and materials

In use now. Will power more in 10-20 years



Credit: Walsh and Beck/Malika Suresh

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How Quantum Benefits Business

Benefit	Example
Solve Problems Faster	Process complex data more quickly, helping businesses make better decisions in less time.
Strengthen Data Security and Next Gen Communications	Quantum-safe communication tools protect sensitive information
Boost Supply Chain Efficiency	Optimization finds the most efficient routes processes and schedules — saving fuel, reducing costs, and cutting emissions.
Discover Better Materials	Simulate how materials behave at the atomic level to design stronger, lighter, or greener products faster. Includes drug manufactur
Predict and Manage Risk More Accurately	Use quantum-powered models to understand market shifts, climate impacts, and financial risks
Reduce Energy Waste	Improve how energy grids and industrial systems operate to save power and lower emissions.
Enable Ultra-Precise Measurements	Photonic-based sensors provide highly accurate measurements. Used in manufacturing, health infrastructure etc
Unlock Innovation Leadership	Early adoption signals forward thinking and commitment to innovation. First-mover advantage in highly competitive sectors.

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AI and quantum – a 2-way street

AI can complement & enhance quantum computing, helping to develop error correction techniques for quantum hardware.

Quantum computers (QC) can simulate complex natural processes more accurately than regular computers.

QC can help AI make more precise predictions about natural phenomena.

QC can generate synthetic data to train generative AI models when real-world data is scarce.

Post quantum encryption

Ising machine

Hybrid algorithms = classical + quantum computing can leverage the strengths of both, potentially leading to more powerful and efficient AI models.

https://www.forbes.com/sites/sylvainduranton/2024/06/26/quantum-now

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Photonic and quantum : Opportunities

CAGR of 2.8% vs 4.8% among competitors and 6.8% global average.

Sector grew from NZ$1.2bn to NZ$1.5bn 2019-2023.

>800 new companies added across Australia and NZ.

Some 4,700 people work in more than 350 businesses in NZ.

SPIE reports global revenues grew by 26 per cent 2020-2022 and demonstrated a 7.3 per cent CAGR over the previous ten years.

Most of this gain was driven by growth in Asia (China, Taiwan, South Korea)

Global quantum market outlook 2040 range from $60bn+ to $103bn. (Quantum Insider and McKinsey)

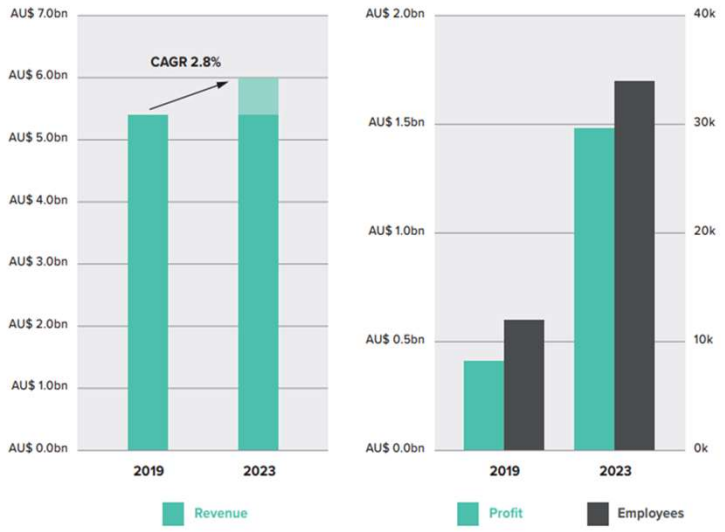

Fig. 4 (Source John Lincoln, Harlin Ltd)

https://thequantuminsider.com/2025/01/15/tqi-2024-annual-report-quantum-industry-faces-challenges-as-transformative-potential-commercialization-beckon/

https://www.mckinsey.cOm/~/media/mckinsey/business%20functions/mckinsey%20digital/our%20insights/quantum%20technology%20sees%20record%20investments%20progress%20on%20talent%20gap/quantum-technology-monitor-april-2023.pdf

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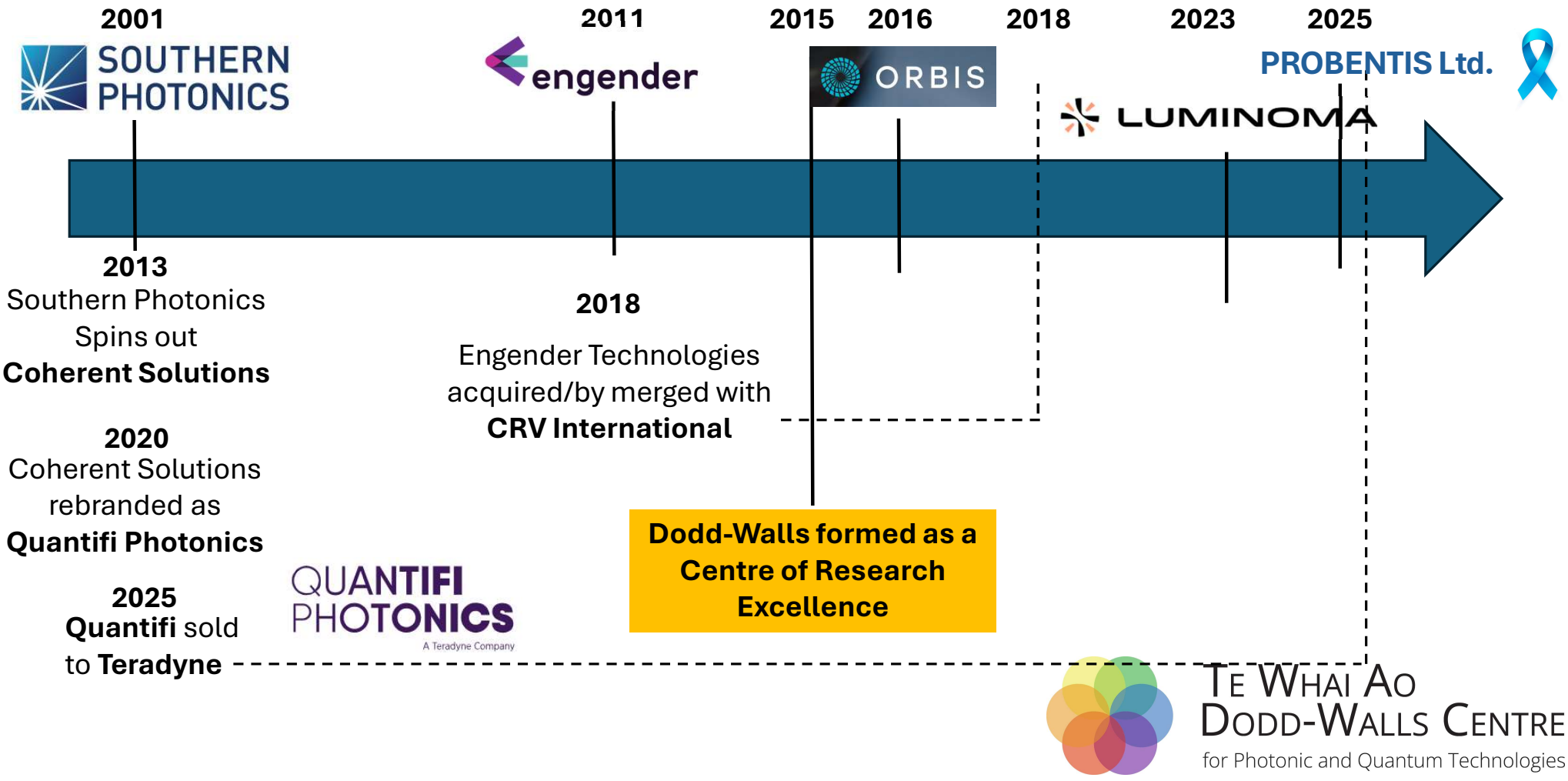
Commercialisation Successes



Healthcare – key challenges/benefits

Logistics – optimizing schedules and systems for better healthcare

Drug development – simulate chemical interactions, measure the effects of drugs

Personalised medicine – assess cellular function, antibiotic resistance, drug and vaccine effects

Diagnostic tools – more specific, less invasive than ever before, more accurate. Saves time, improves outcomes.

Secure data – cryptography can ensure private, secure data

Credit: Florey Institute https://www.flickr.com/photos/153257761@N07/26959885879/

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Healthcare – a case study: The cochlea

- Poorly managed hearing loss costs New Zealand around $4.6 billion annually.
- ~880,000 people affected.
- The cochlea of the inner ear is one of the most difficult human organs to access.
- Developing a medical device for insertion down the ear canal, through the eardrum to assess the cochlea and quickly deliver treatment.
- Researchers have invented a prototype device that uses ultrasound to do this.
- Working on a pre-clinical programme to study ear disease and hearing loss to deliver better disease detection and monitoring.

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Biomedical applications

Multimodal sensing

- Combine several spectroscopy and optical imaging techniques
- Myriad of applications
  - ✓Primary industries – milk, beef, pasture quality
  - ✓Sensing & protecting our cultural & natural world
  - ✓Tissue oxygenation & vascularization
  - ✓Bacterial separation & analysis
  - ✓…
- Work for/with industry and stakeholders from health, agritech and pharma sectors

Mātai Te Mata Mātai Hura Mātai Medical Research Institute TAIRĀWHITI GISBORNE | NEW ZEALAND

Nycrist

COUNTIES MANUKAU HEALTH

ZERION

TE TĪTOKI MATAORA MEDTECH RESEARCH TRANSLATOR

Zespri KIWIFRUIT

CENTRE FOR BRAIN RESEARCH THE UNIVERSITY OF AUCKLAND Te Whare Wānanga o Tāmaki Makaurau

Fonterra Dairy for life

veriphi

timegate

ORITAIN PROVING ORIGIN, PROTECTING REPUTATIONS

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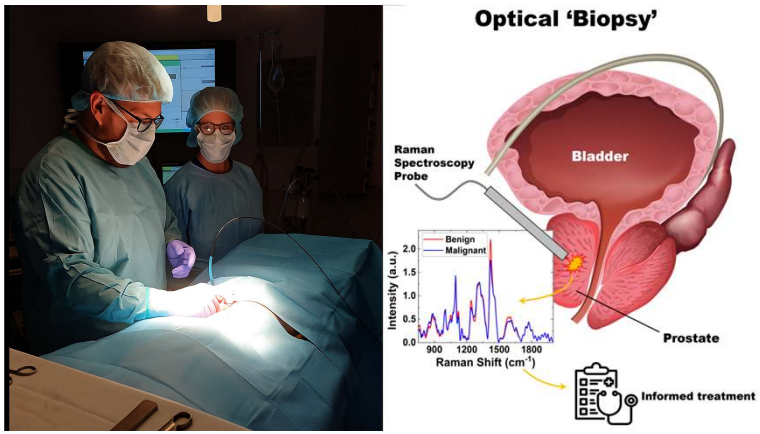
Spin outs

LUMINOMA

LUMINOMA WILL TRANSFORM THE WAY SKIN CANCER IS DIAGNOSED

MICHEL NIEUWOUDT



PROBENTIS Ltd.

PROSTATE CANCER DETECTION MADE EASY

CLAUDE AGUERGARAY

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From photonics to quantum technologies

USING THE QUANTUM PROPERTIES OF LIGHT UNLOCK THE "QUANTUM" ADVANTAGE
QUANTUM PROPERTIES OF LIGHT MEAN COHERENCE AND CORRELATION

Examples:
Quantum optical coherence tomography
- is immune to some instabilities
- offers a better resolution than classical OCT

Quantum microscopy
- offers better resolution (Michael Taylor Otago)

Quantum stimulated Raman scattering
- offers faster measurement time

Reference:
Hoda Lotfipour, Hassan Sobhani, Mohamad Taghi Dejpasand, and Morteza Sasani Ghamsari, "Application of quantum imaging in biology," Biomed. Opt. Express 16, 3349-3377 (2025)
https://opg.optica.org/boe/fulltext.cfm?uri=boe-16-8-3349&id=574610

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Quantum material for biological sensing

New contrast agents allow live cell imaging and theranostics.

- Examples:
  - Nanodiamond
  - Quantum dots
  - NV diamonds

Reference:
Hoda Lotfipour, Hassan Sobhani, Mohamad Taghi Dejpasand, and Morteza Sasani Ghamsari, "Application of quantum imaging in biology," Biomed. Opt. Express 16, 3349-3377 (2025)
https://opg.optica.org/boe/fulltext.cfm?uri=boe-16-8-3349&id=574610

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The role for business

RISKS: global relegation, insufficient skills, no technology, no supply chain, sovereign threat.

Quantum helps solve the big challenges for Health:

- Artificial Intelligence
- Environmental sustainability
- More accurate measurement
- Minimally invasive
- Low cost and low resources

Role of industry and your part in keeping NZ competitive:

- Be part of the ecosystem that mobilises science
- Be informed – stay relevant, hear from us in an industry workshop
- Engage with us - meet our scientists
- Present us with a problem – generate use-cases
- Work on mission-led research with us – foster strategic partnerships
- Harden security protocols & build internal quantum expertise
- Hire from us

https://www.forbes.com/sites/sylvainduranton/2024/06/26/quantum-now/
https://www.quantumlah.org/industry/#

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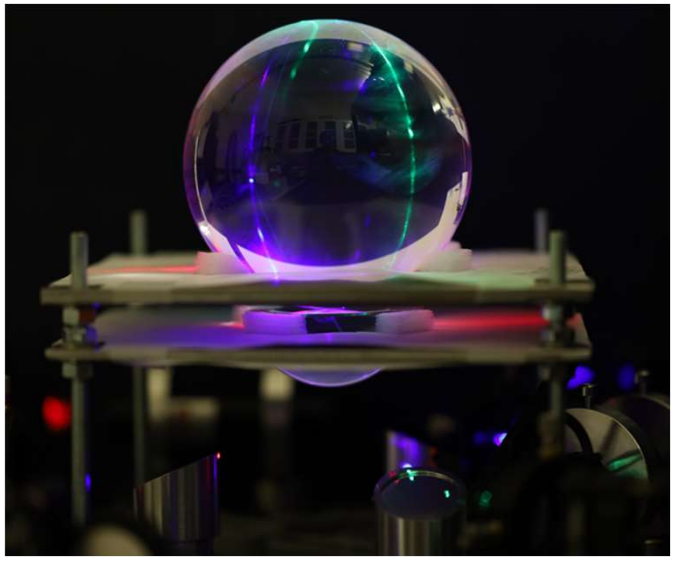
Next steps

Why Now?

- What are your competitors doing ?
- Other national quantum initiatives and funding (e.g., Scotland, UK 5 Pillars, Australia , EU.
- Align with broader digital transformation strategies.
- Even if full advantage is years away, the time to learn and invest is now.

How Businesses Can Engage Today

- Build internal awareness and find a champion
- Start experimenting via cloud platforms
- Plan for quantum-safe security
- Try some Near-Term Value (Quantum-Inspired Solutions) “Quantum-inspired” algorithms (running on classical hardware) to provide early ROI while building internal expertise, ease the transition to full quantum readiness.
- Industry forum at ANZCOP Dec Auckland
- Be curious



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Be curious

Quantum insider: https://thequantuminsider.com/

Search Results for: health

Home » You searched for health

UChicago Receives $21 Million to Establish Quantum Engineering And Health Center

Matt Swayne . June 5, 2025

Study Finds Challenges, Promise For Quantum Computing in Healthcare

Matt Swayne . May 31, 2025

More than 100 results

Cleveland Cli

CAS

CAS and Cleveland Clinic Partner to Advance Brain Health Research with AI and Quantum Computing

Cierra Choucair . April 8, 2025

National Quantum Computing Centre's Paper Explores Quantum Computing's Transformative Potential in Healthcare And...

Matt Swayne . March 26, 2025

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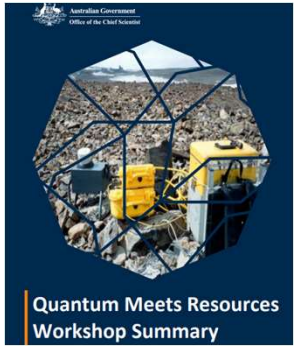
Be curious

Quantum insider: https://thequantuminsider.com/ (science, business and policy)



www.qureca.com – quantum tech resources and information

Dr Cathy Foley Quantum 101 webinar 14 July (very good intro!)
https://shorturl.at/kbzwk

Quantum Meets Australia-
https://www.chiefscientist.gov.au/news-and-media/quantum-meets-workshop-series

Photonic and Quantum Technologies in Australia and New Zealand 2024 Industry report - https://shorturl.at/81XiI or search Dodd-Walls Centre site www.doddwalls.ac.nz

MacDiarmid Institute – www.macdiarmid.ac.nz

Paihau-Robinson Research Institute – www.wgtn.ac.nz/robinson

https://www.medtechiq.co.nz/

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Thank you

Contact: f.vanholsbeeck@auckland.ac.nz

Partnership inquiries: zahrachampion_DWC@outlook.com

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