

Photonic & quantum technology capabilities in New Zealand

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for Photonic and Quantum Technologies

Photonic & quantum technologies – NZ institutions & networks



doddwalls.ac.nz

Photonics, the generation, transmission, and manipulation of light, and the study of matter and energy at the quantum level

Three beacons:

- The One – ***quantum technologies*** and photonic sensing
- The Many – ***many-body quantum and classical systems***
- The All – ***optical imaging and spectroscopic sensing***

Quantum Technologies Aotearoa



Tertiary Partners



Non-Tertiary Partners



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Quantum Technologies Aotearoa

qta.otago.ac.nz



- A globally connected research programme to ensure NZ benefits from the advancement and adoption of quantum technologies
- Five year programme 2024-2028.
- Focus is international collaboration with 6 target countries:
 - US, UK, Germany, Singapore, Japan, South Korea
- Administered by DWC. Funded by MBIE Catalyst Strategic Fund.



Outline

- What are quantum technologies and why are they revolutionary?
- Why are quantum technologies important?
- Agriculture – key challenges?
- Capacity at Te Whai Ao



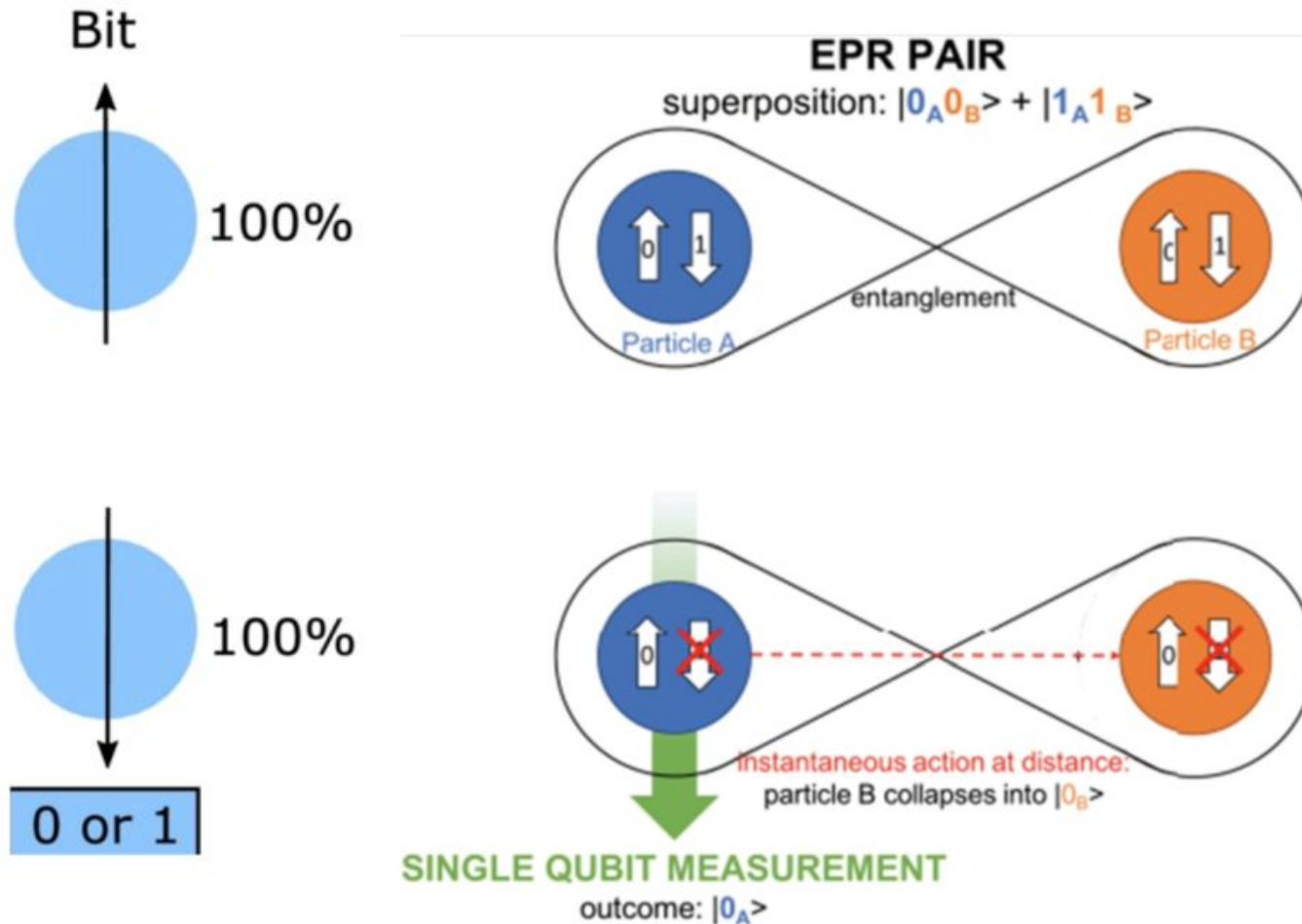
Credit: Paul Sutherland Photography <https://toolkit.nzstory.govt.nz/assets/213134?tags=Image,Services>



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What are quantum technologies and why are they revolutionary?

Noise is reduced by quantum entanglement



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.

Agriculture – key challenges/benefits

1. Animal Health & Monitoring - Quantum sensors enable early disease detection. Photonic biosensors monitor milk composition (fat, protein, somatic cell count) during milking.

Benefit: Reduces vet costs, improves herd welfare, and maximizes milk quality and yield.

2. Precision Feed & Pasture Management - Quantum-enhanced soil sensors accurately analyse nutrient levels and moisture. Photonic remote sensing (via drones or satellites with hyperspectral imaging) provides real-time pasture quality maps, crop monitoring for disease and optimizes feed planning.

Benefit: Improves feed conversion efficiency and optimises feeding.

3. Supply Chain Traceability & Quality Assurance - Quantum-secure communication (e.g. QKD) ensures unbreakable traceability records from farm to processor. Photonic sensors in milk tankers monitor for temperature and contaminants.

Benefit: Verifiable quality and traceability. Ensures regulatory compliance.

4. Environmental Monitoring & Emissions Control - Quantum sensors can detect ultra-low concentrations of gases like methane and ammonia which can be paired with photonic gas analyzers for continuous emissions monitoring on-site.

Benefit: Supports efforts to reduce greenhouse gas emissions.



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A selection of Te Whai Ao Dodd-Walls Centre innovations

Photonics is the framework of quantum technology

Photonics-based sensing

Development into quantum tech devices



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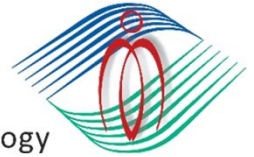
High-speed linear-rail laser scanner - highlights

D&K Technology

Projects

Systems

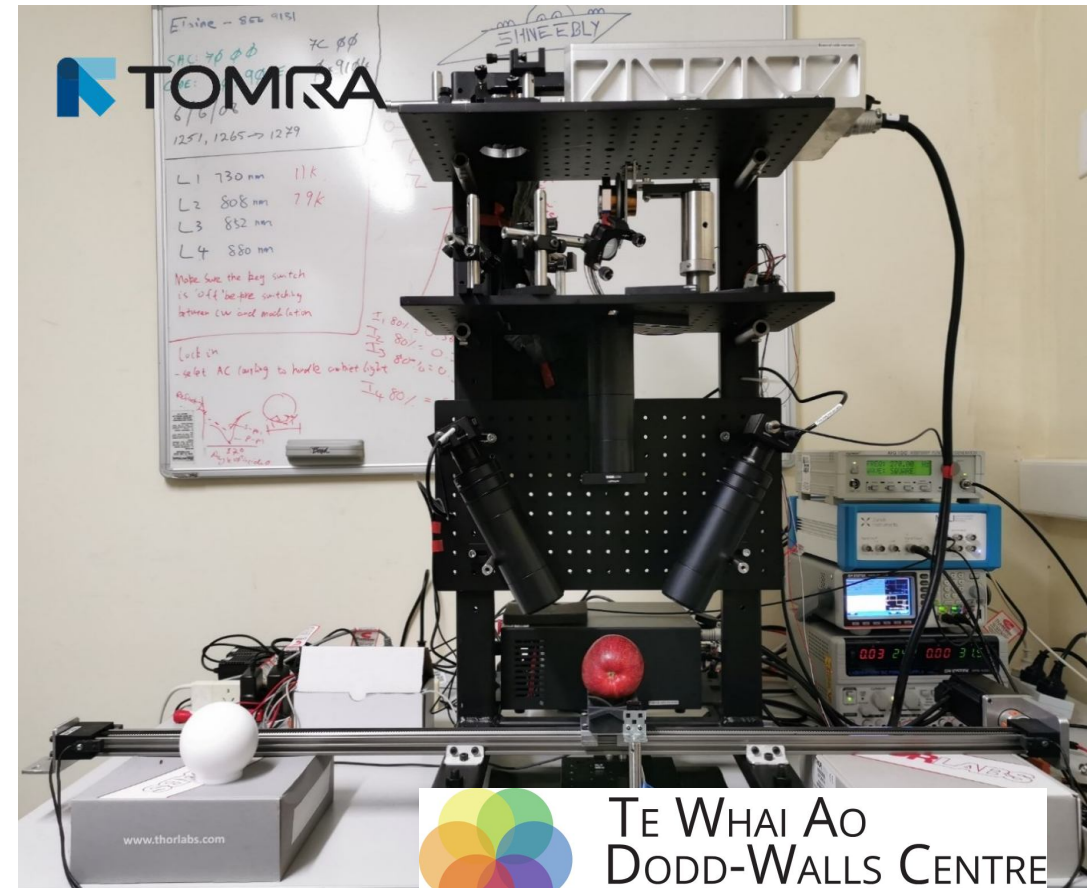
Technology



We developed a system to detect internal defects in fruit. The system ...

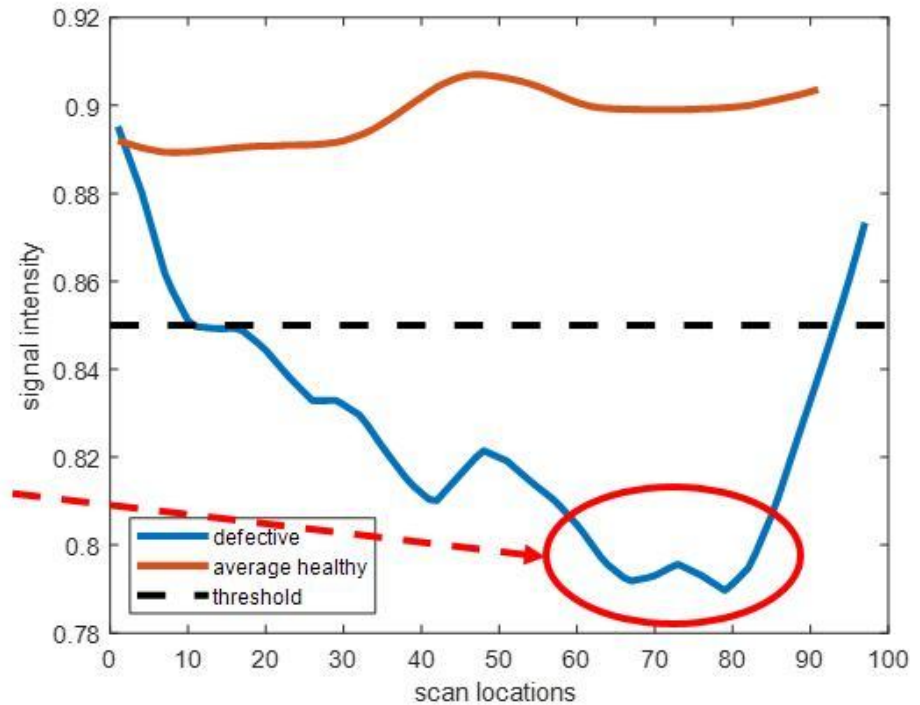
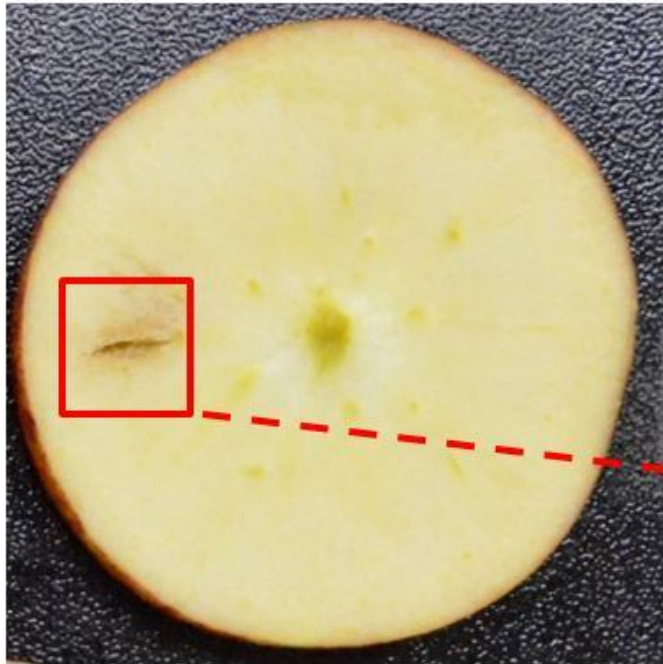
- was tested on internal browning in 'Scilate' apples;
- can detect even slight defects;
- accuracy, in terms of defect identification, is as good as, or better than traditional spectroscopy methods;
- operates at high fruit moving speeds suitable for commercial applications;

Zhen Wang
Jason Sun,
Andrew McGlone
Rainer Künnemeyer



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Accuracy

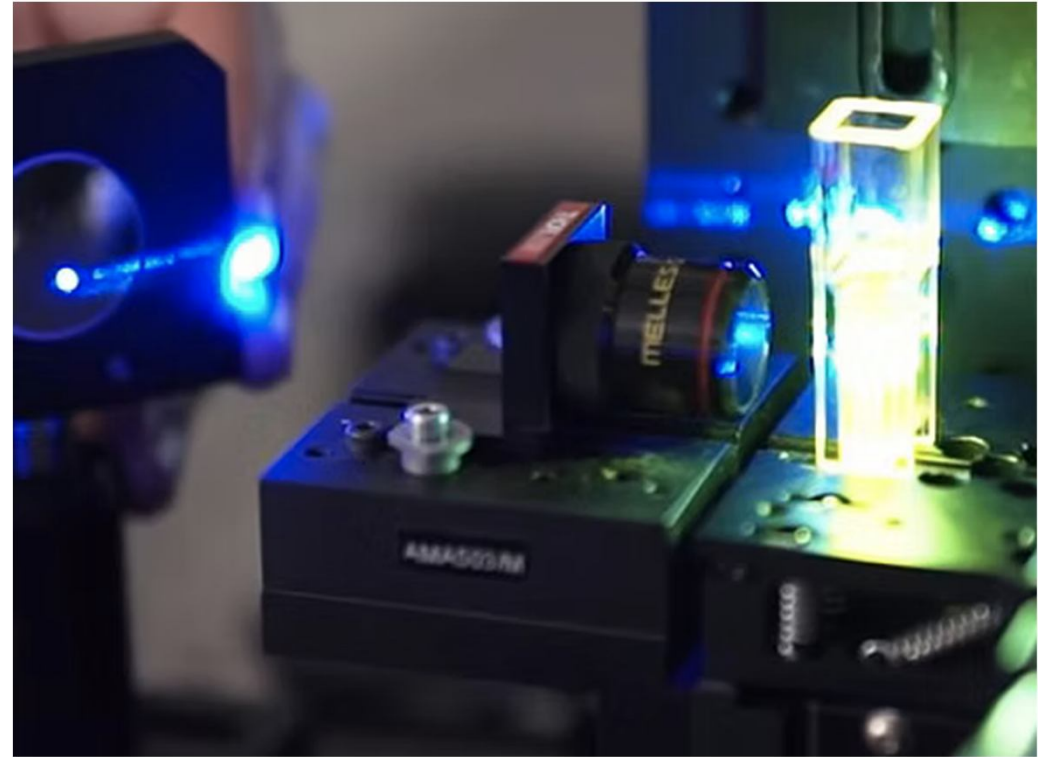
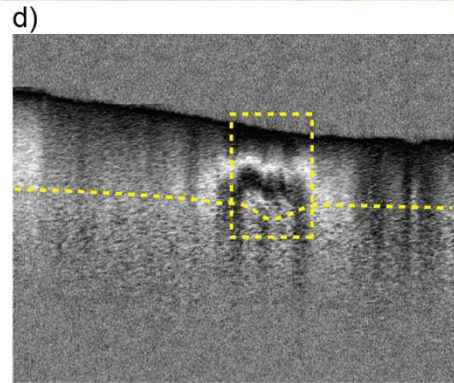
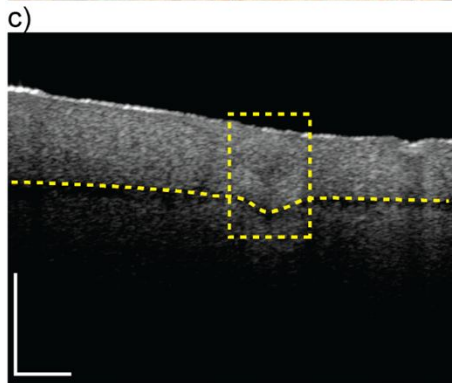
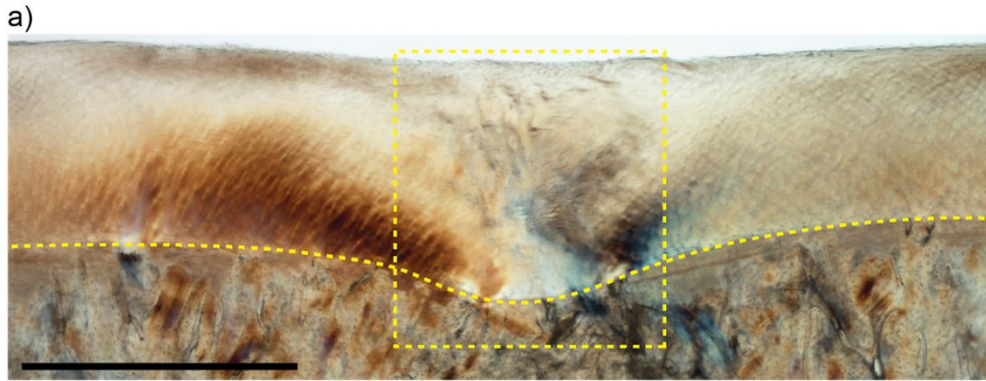


- The system was able to detect slight, localized defects, as illustrated, from its scan profiles.
- The overall classification accuracy for healthy and slightly defect fruit was 92%.



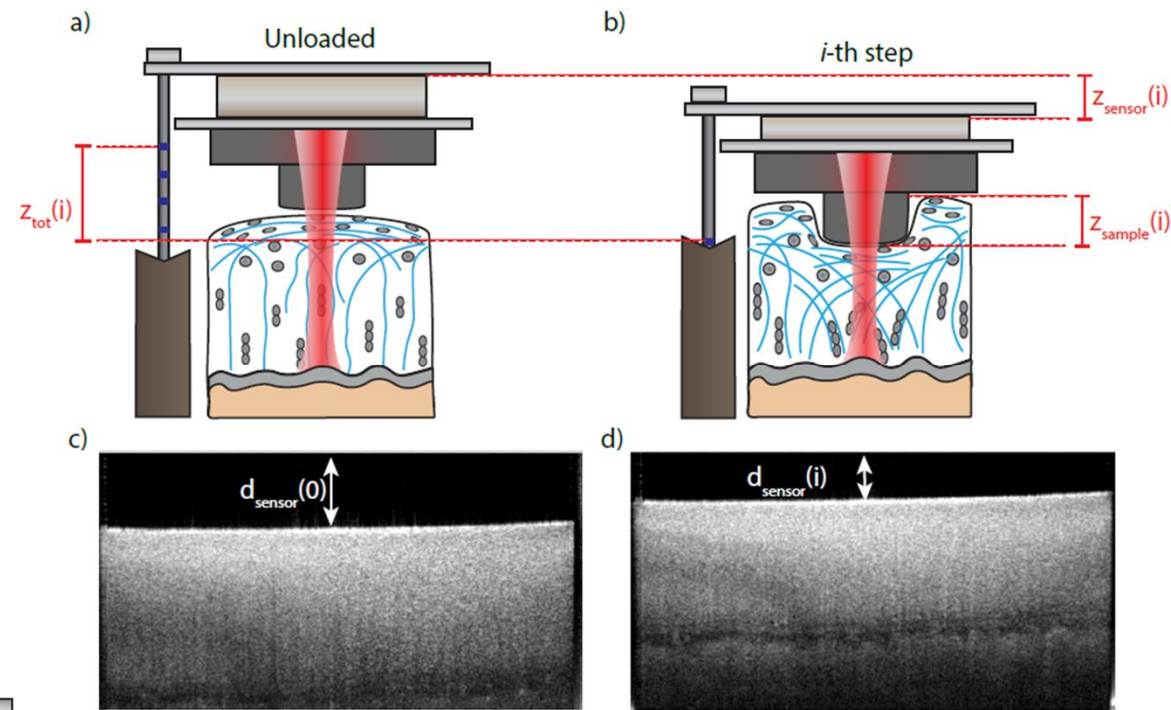
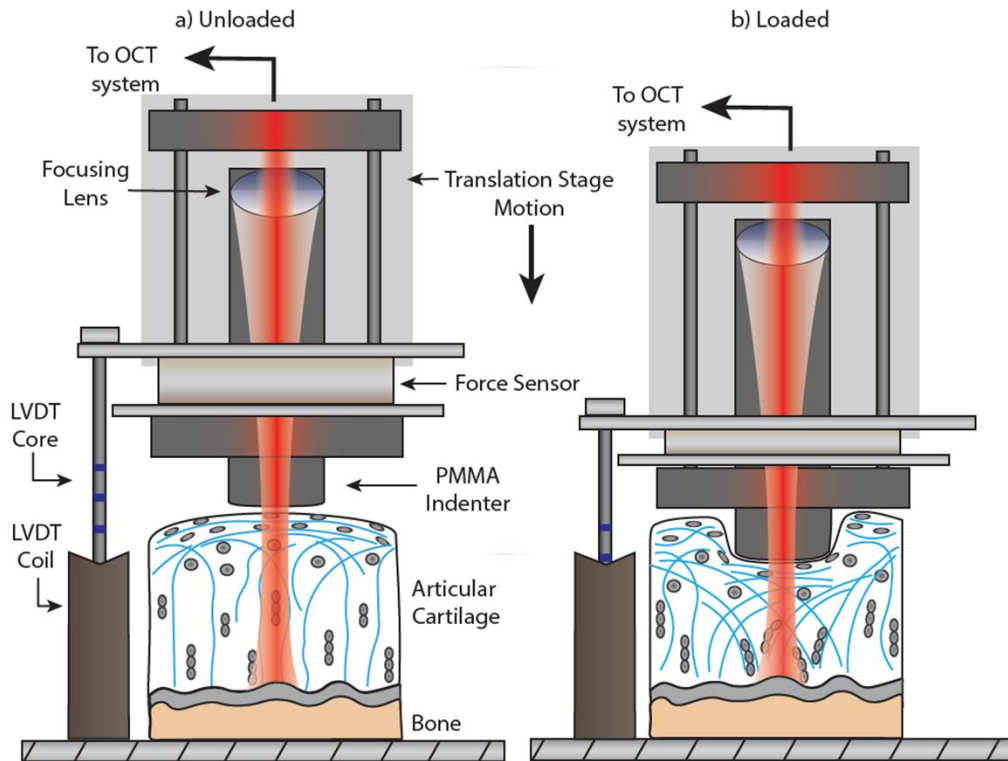
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PS-OCT detects defect below the surface in cartilage



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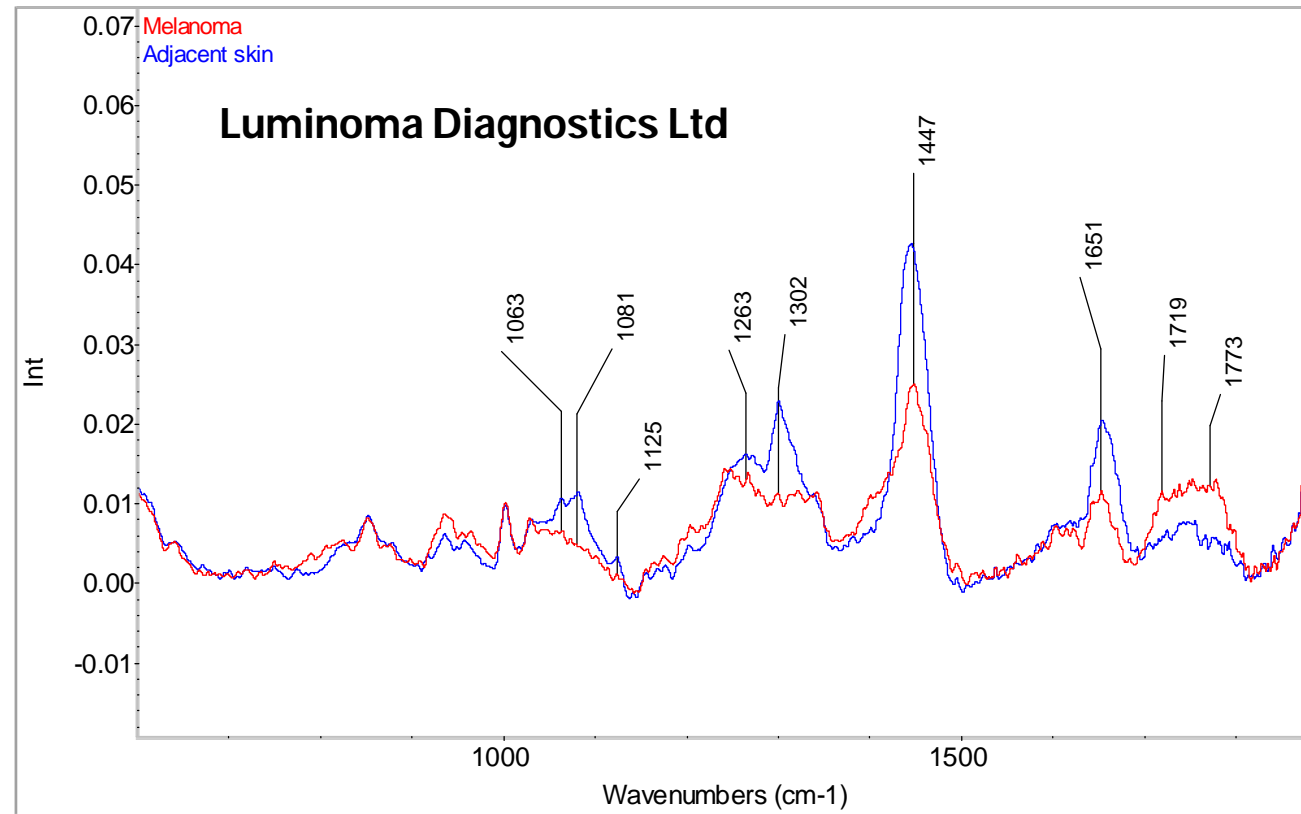
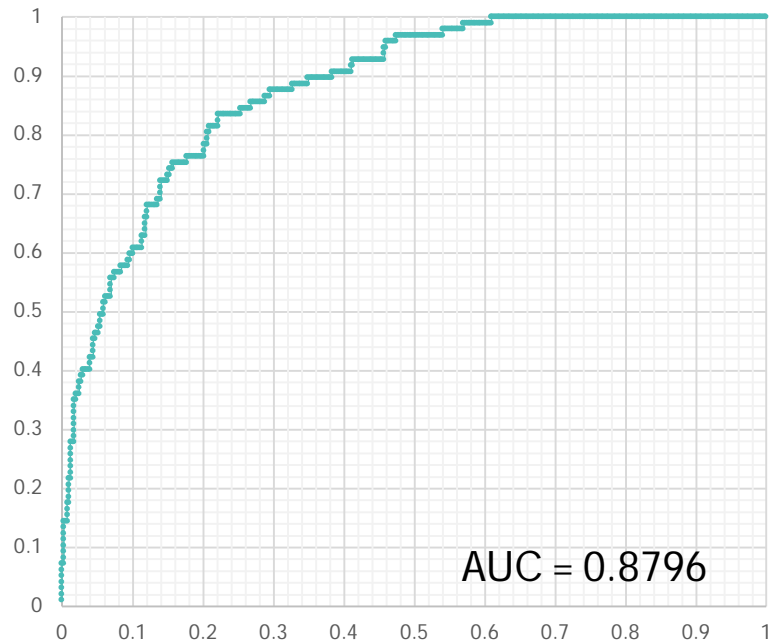
Dynamic imaging under controlled load



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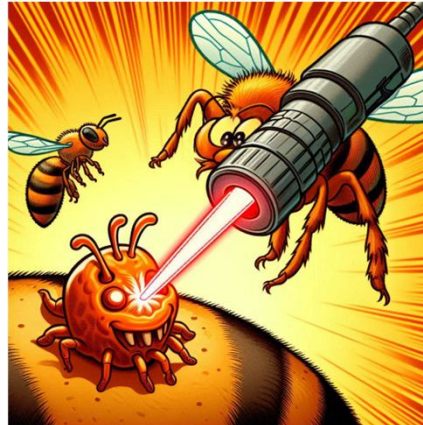
Raman spectroscopy for in vivo skin cancer detection

ROC for classifying melanomas from benign lesions



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Vaorra Mite eradication



FRANCESCO MEROLA



The experiment focuses on testing how different laser blasts affect bees and mites, working in a containment laboratory at a Plant & Food Research facility in Hamilton.

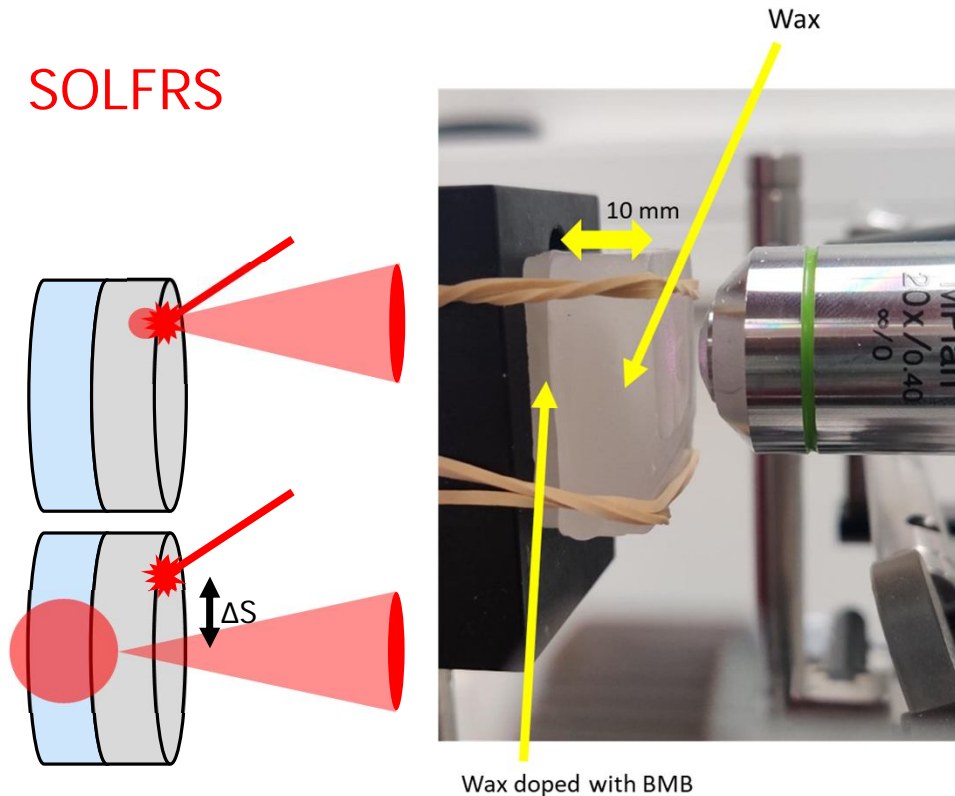


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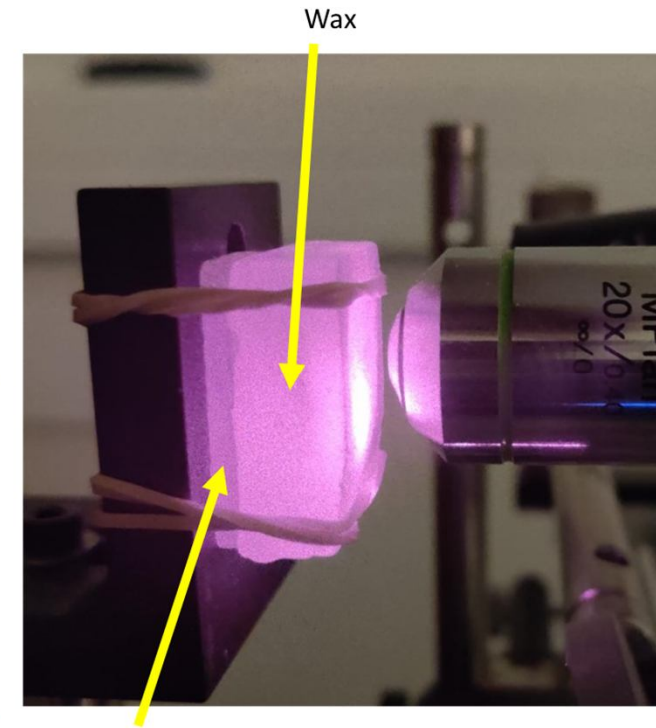
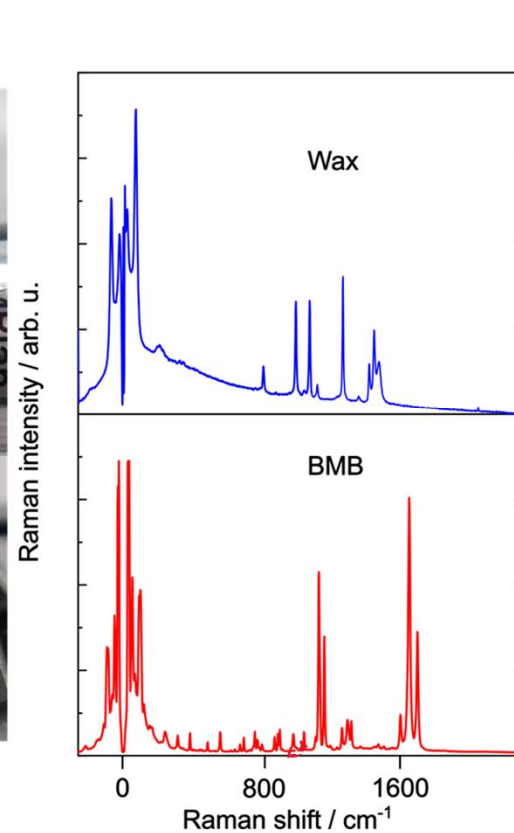
Seeing beneath the surface

Spatially offset Raman Low frequency Raman

SOLFRS



Wax doped with BMB

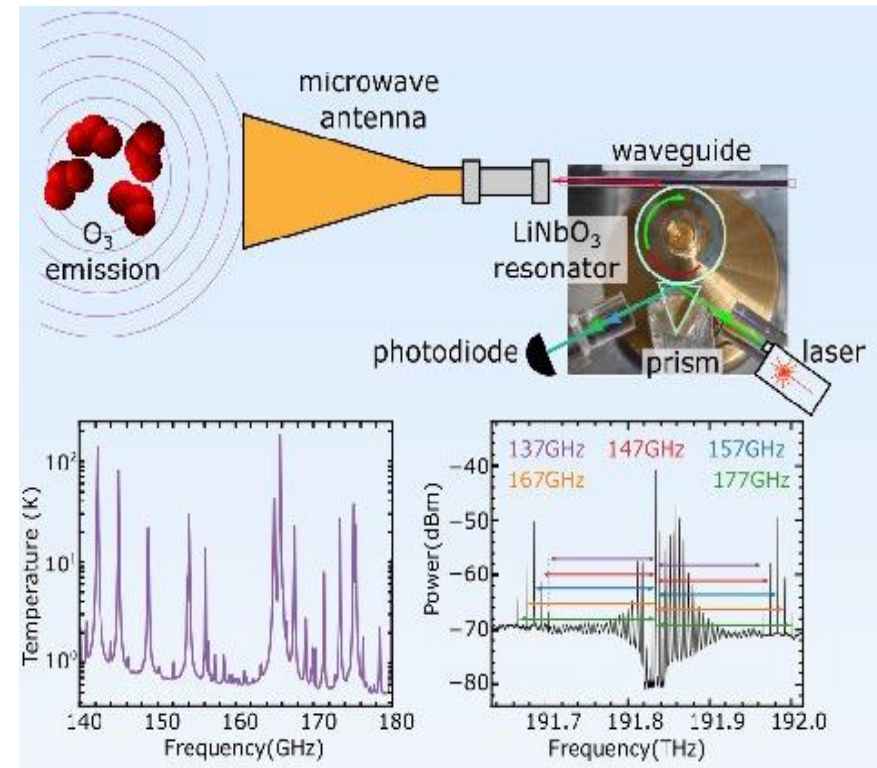


Wax doped with BMB



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Example of new sensors



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Intelligent Processing of Fish Biomass

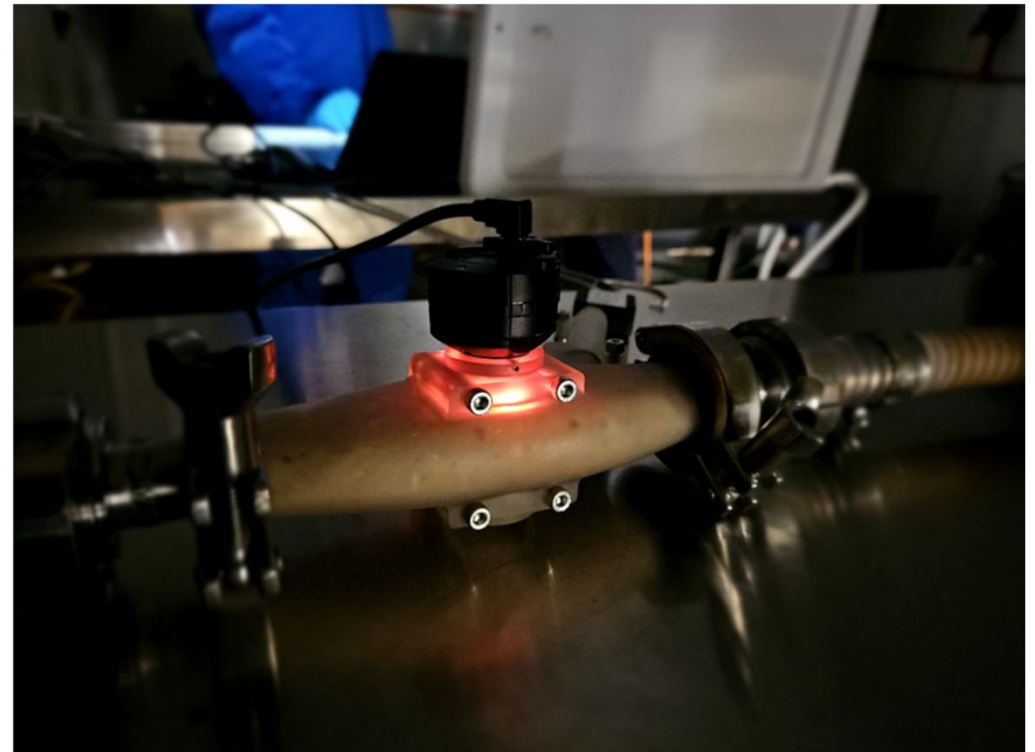
Market for collagen products estimated at USD\$10-11bn.
Predicted to double by 2032.

Research to develop new sustainable technologies for seafood processing, improving the take from by-products and by-catch with intelligent handling.

Marine molecules include: big structural proteins for bio-medical scaffolds, anti-inflammatory omega-3's, anti-aging peptides, industrial biomaterials such as enzymes and polymers, collagen.

Challenge: how to efficiently extract molecules from really diverse marine organisms whilst not destroying one component to recover another.

Spectroscopic analysis: lasers detect the composition of materials in different seafood in real-time, direct how each will be handled, extracting all available molecules & keeping their useful properties. Highly precise, low-impact, non-invasive technique.

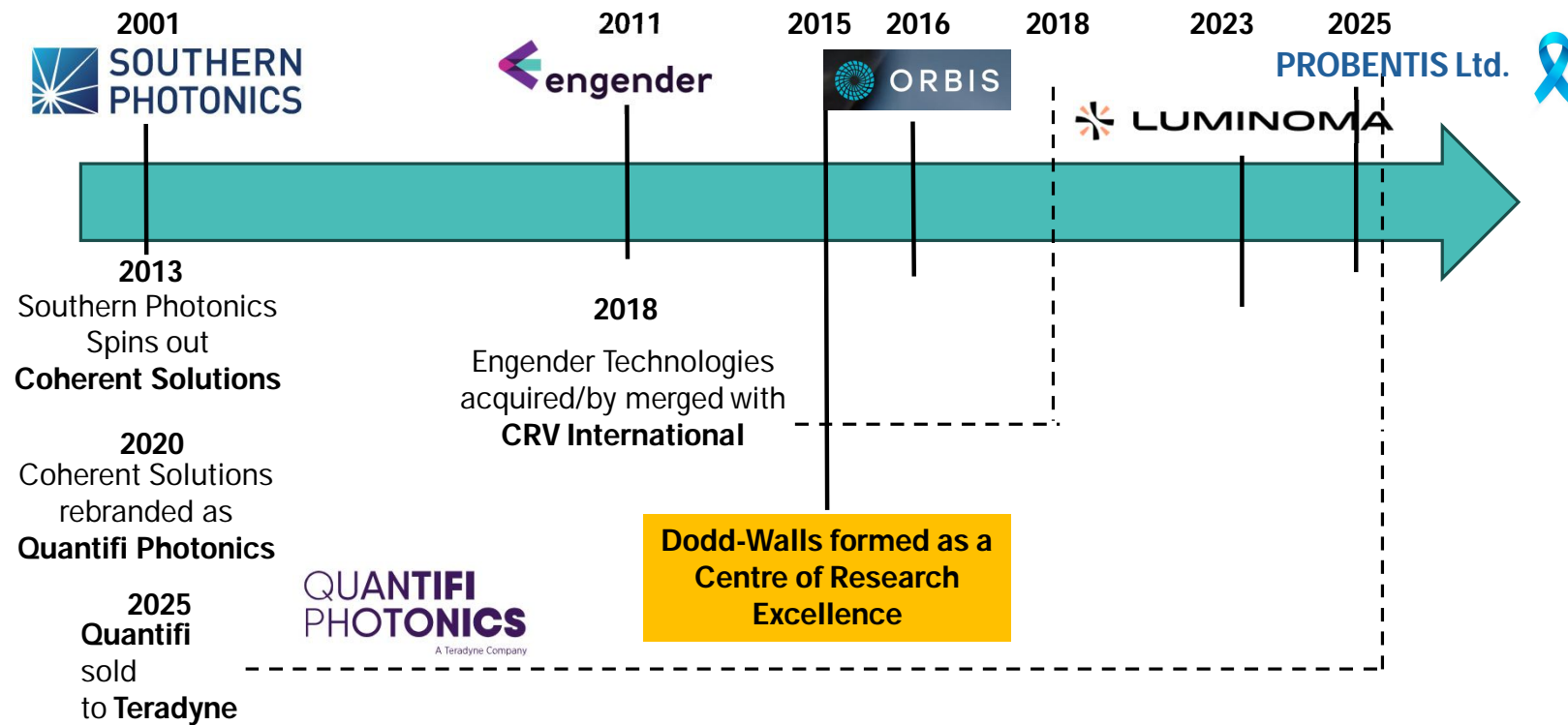


Spectroscopic analysis of fish biomass. Source: Cyber-Marine Institute - Plant and Food Research.



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Commercialisation Successes



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Spin outs



Benign Melanocytic Naevus Malignant Melanoma

Dermoscopy

At least 1 in 8 cancers missed



LumAssure

<1 in 100 cancers missed



LUMINOMA

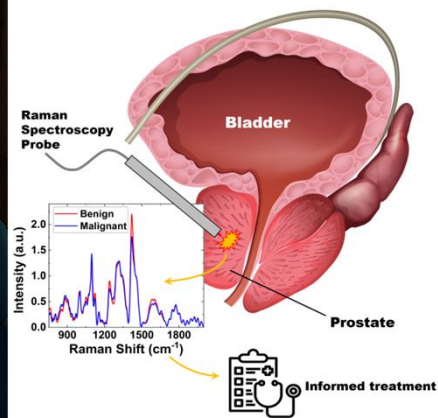
MICHEL NIEUWOUDT



LUMINOMA WILL
TRANSFORM THE
WAY SKIN CANCER
IS DIAGNOSED



Optical 'Biopsy'



PROSTATE
CANCER
DETECTION
MADE EASY

PROBENTIS Ltd. 

CLAUDE AGUERGARAY



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New Zealand's competitive advantages

Pockets of deep world-class expertise, patents and other IP

- Sensing and imaging; optical-microwave interconversion
- Cold atoms, atomic spectroscopy
- Photonic materials and devices

Strong networks of NZ researchers, linking capabilities

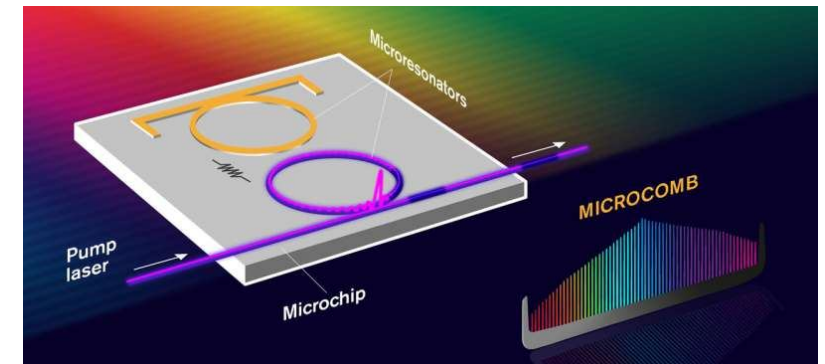
- Dodd-Walls, QTA, MacDiarmid

Strong international partnerships with leading quantum nations

- Japan, Germany, UK, Singapore, US, EU, South Korea, Australia...

Chasing the Sir Paul Callaghan 'niche' applications ignored by others

- Photonic and electromagnetic sensing
- Quantum computer control electronics
- Quantum memories for secure communications

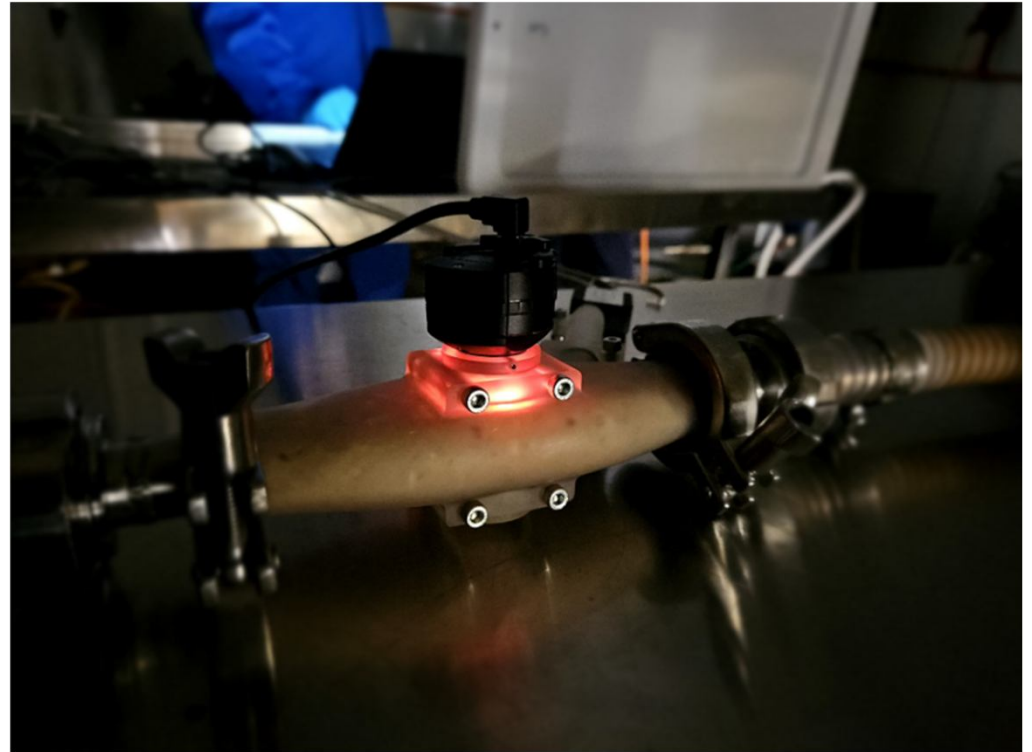


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Useful links

Useful links

- 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



Spectroscopic analysis of fish biomass. Source: Cyber-Marine Institute - Plant and Food Research.



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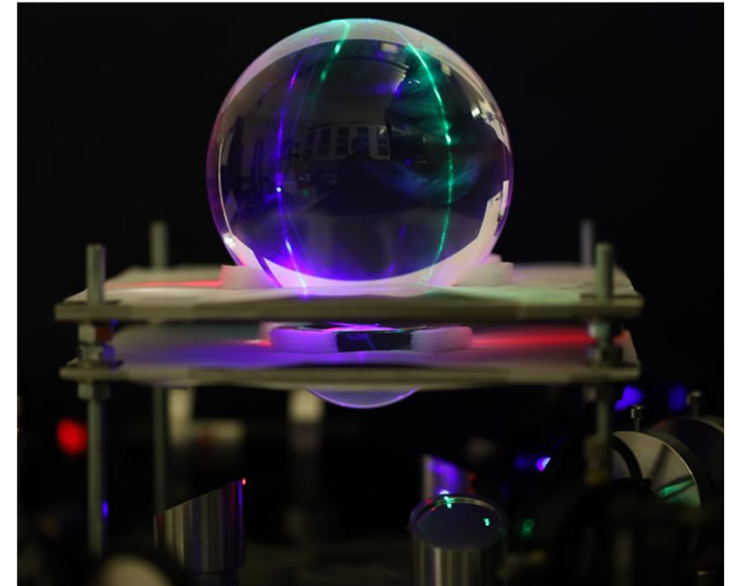
Next steps

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

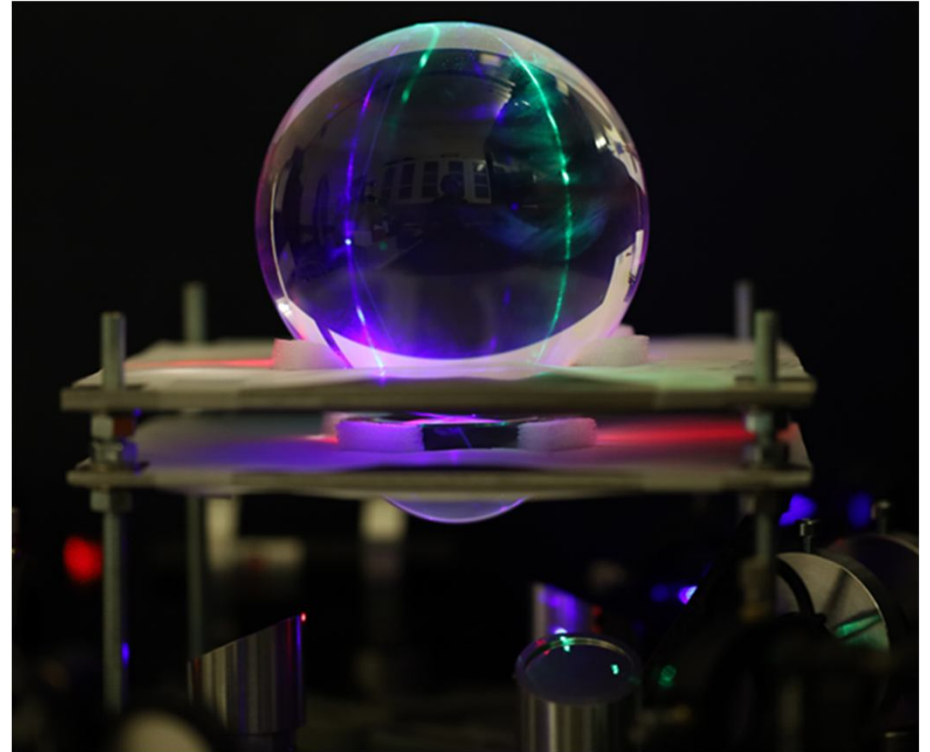


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Thank you

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**Partnership inquiries:
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