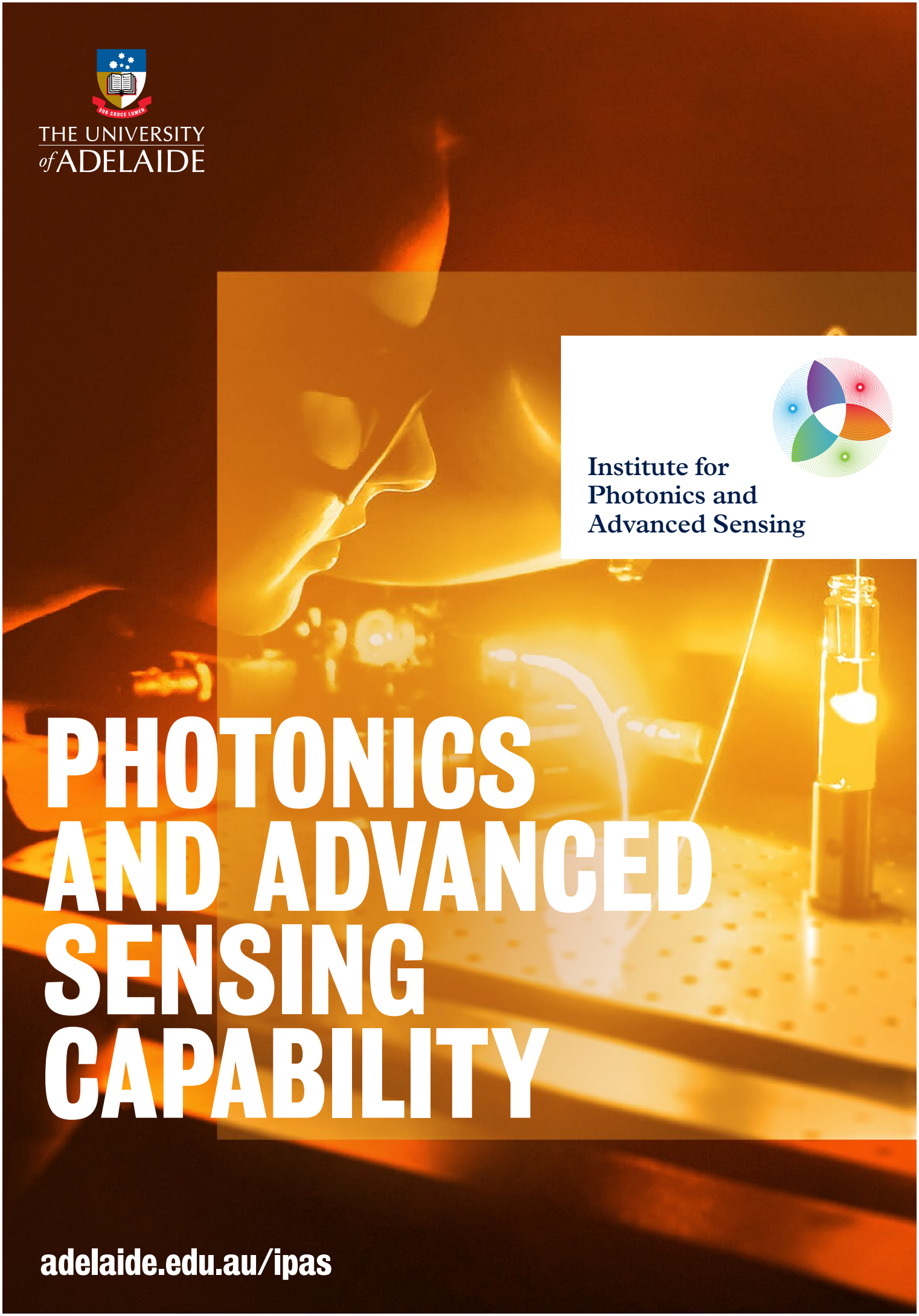

THE UNIVERSITY
of ADELAIDE
Institute for
Photonics and
Advanced Sensing
PHOTONICS
AND ADVANCED
SENSING
CAPABILITY
adelaide.edu.au/ipas

WE HOPE THAT, THROUGH THE POWER OF LIGHT, WE CAN ENHANCE OUR COMMUNITY'S HEALTH, PROSPERITY AND SAFETY.

WELCOME

The University of Adelaide's institutes are globally recognised for their research quality and extensive connections with industry, government and the wider community.

The Institute for Photonics and Advanced Sensing (IPAS) houses over 200 researchers, with backgrounds in physics, chemistry and biology. Together, they are expanding knowledge and creating innovative new technologies to solve problems in areas such as health, the environment, mining, space and defence.

Combining scientific and technical excellence with a strong external-engagement focus, IPAS facilitates and accelerates industry development. Some of its key existing partnerships include: the Defence Science and Technology Group; the South Australian Government and global semiconductor manufacturer Silanna.

If you share the institute's vision to make the world a safer, healthier and wealthier place using the power of light, you'll find no better partner.

Professor Peter Høj AC
Vice-Chancellor and President
The University of Adelaide

ABOUT THE INSTITUTE

With over 200 researchers working across the areas of physics, engineering, maths, chemistry and biology, IPAS is at the leading edge of global research in advanced photonic sensing.

Our scientific and technical excellence complements a long history of facilitating industry development. We offer a unique platform for external engagements, due to our breadth of work and effective delivery on research and industry projects.

We also deliver on our vision by helping our researchers commercialise their innovations.

Our intellectual property has underpinned a number of IPAS contributors' photonic companies.

Mission and vision

Many of today's problems can be overcome by combining specialist knowledge in science, engineering and technology with an entrepreneurial mindset.

At IPAS we see our mission as building transdisciplinary research to develop groundbreaking sensing and measurement technologies. We hope that, through the power of light, we can enhance our community's safety, health and prosperity.

Photonics

Photonics is the science and technology that allows the generation and control of light.

Photonics gives us new tools for measurement – including ultra-fast, sensitive and portable sensors to support decision making, and new light sources for use in material processing and medical treatments.

Photonics research is driving the development of new technologies to underpin transformations in manufacturing, health, agriculture, mining, space, defence and the environment.

IPAS AT A GLANCE

380+ PUBLICATIONS

10+ JIF* **33** PUBLICATIONS

10+ JIF* **90** PUBLICATIONS

**Journal impact factor*

10 RESEARCH LEADERS

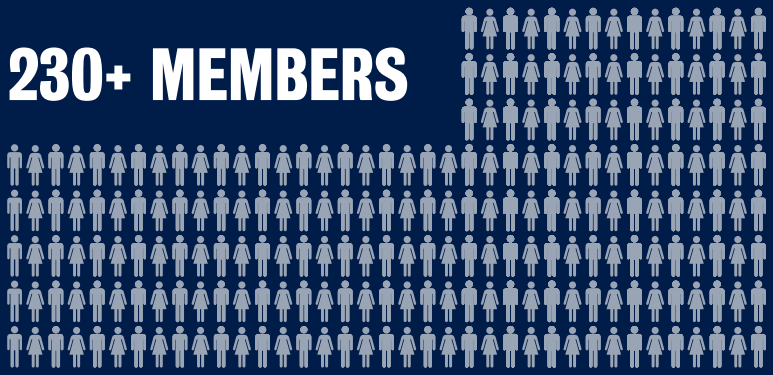
$15M+ RESEARCH FUNDING (2020)

07 START-UPS LAUNCHED

06 AREAS OF STRENGTH

RATED 5, 'WELL ABOVE WORLD STANDARD', ACROSS THE BOARD IN ALL FOUR AUSTRALIAN RESEARCH COUNCIL EXCELLENCE IN RESEARCH FOR AUSTRALIA ASSESSMENT ROUNDS (2010, 2012, 2015, 2018)

230+ MEMBERS



12 HONOURS STUDENTS
15 MASTER-DEGREE STUDENTS
66 PHD STUDENTS

RESEARCH WITH IMPACT

The Institute for Photonics and Advanced Sensing drives a transdisciplinary approach to science and excellence in research through the development of disruptive new sensing and measurement technologies.

At IPAS we give businesses and organisations a competitive advantage through next-generation technologies offering greater sensing reach and more precise measurement.

Our engagement with industry ranges from solving specific end-user problems to providing access to cutting-edge manufacturing infrastructure for proof-of-concept materials and prototype devices.

This work's outcomes and impacts, some of which you'll learn about in the following pages, range from scientific discoveries and innovations, to spin-out companies and job creation. Over 40 per cent of our income is connected to industry.

Our areas of strength

IPAS's industry-leading research is focused on six key areas:

- Defence and Security
- Space Science & Astrophysics
- Health and Biotech
- Energy, Mining and Resources
- Advanced Manufacturing
- Agri-food and Wine

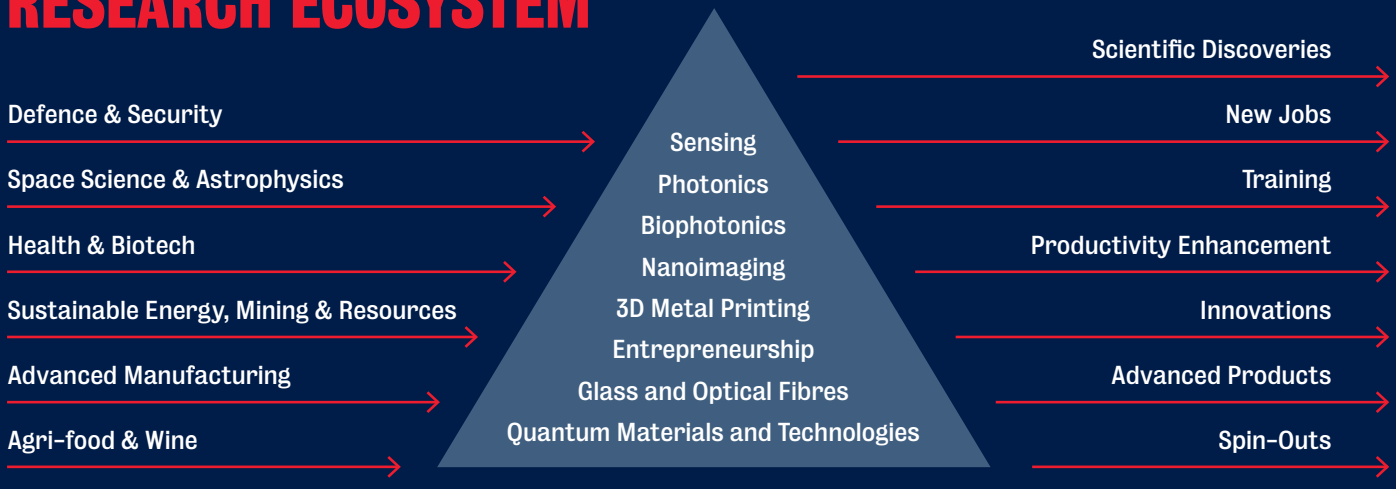
Outstanding transdisciplinary headquarters

Our $96M headquarters, The Braggs, is a unique transdisciplinary University of Adelaide building that enables IPAS researchers to be co-located with students from a broad range of scientific fields.

The building also houses a similarly wide range of state-of-the-art facilities. These support research in:

- Precision measurement—time, temperature and frequency
- Photonic sensor development
- Advanced manufacturing, including 3D polymer and metal printing
- Glass and optical-fibre development and processing
- Laser development
- Luminescence dating and radiation measurement
- Quantum materials.

IPAS TRANSDISCIPLINARY RESEARCH ECOSYSTEM



Themes **Capabilities** **Impact**

MEET OUR DIRECTOR

IPAS's vision is to develop innovative sensors to make the world healthier, wealthier and safer. I think you can see from the stories contained in this document that we are accomplishing across the spectrum of our vision.

Professor Andre Luiten, FAIP GAICD Chair of Experimental Physics

Prof Andre Luiten FAIP GAICD FTSE is Director of the Institute for Photonics and Advanced Sensing (IPAS) and Chair of Experimental Physics at the University of Adelaide. He is a Fellow of the Australian Institute of Physics and of the Australian Academy of Technology and Engineering.

Andre obtained his PhD in Physics from the University of Western Australia in 1997, for which he was awarded the Bragg Gold Medal. He has subsequently held three prestigious Fellowships from the ARC. For his efforts Andre was the joint inaugural winner of the WA Premier's Prize for Early Career Achievement in Science. Andre came to the University of Adelaide in 2013 to take up the Chair of Experimental Physics and a South Australian Research Fellowship from the Premier's Research and Innovation Fund.

Andre's work is aimed at the development of state-of-the-art instruments across many diverse fields of physics. He has published 6 book chapters and authored 132 journal papers (with over 5,600 citations), has over 110 conference papers, and has raised over $35M for research. The excellence of his research has been recognised by the award of the Barry Inglis Medal from the National Measurement Institute, which acknowledges outstanding achievement in measurement research and excellence in practical measurements, the Australian Institute of Physics' Alan Walsh Medal for Service to Industry and the prestigious 2018 Eureka Prize for Outstanding Science in safeguarding Australia.

Andre is also the co-founder and managing Director of QuantX Labs, a successful start-up commercialising the world's most precise clock (Cryoclock) and developing the highest precision timing and sensor products.

INNOVATIONS IN PLAY

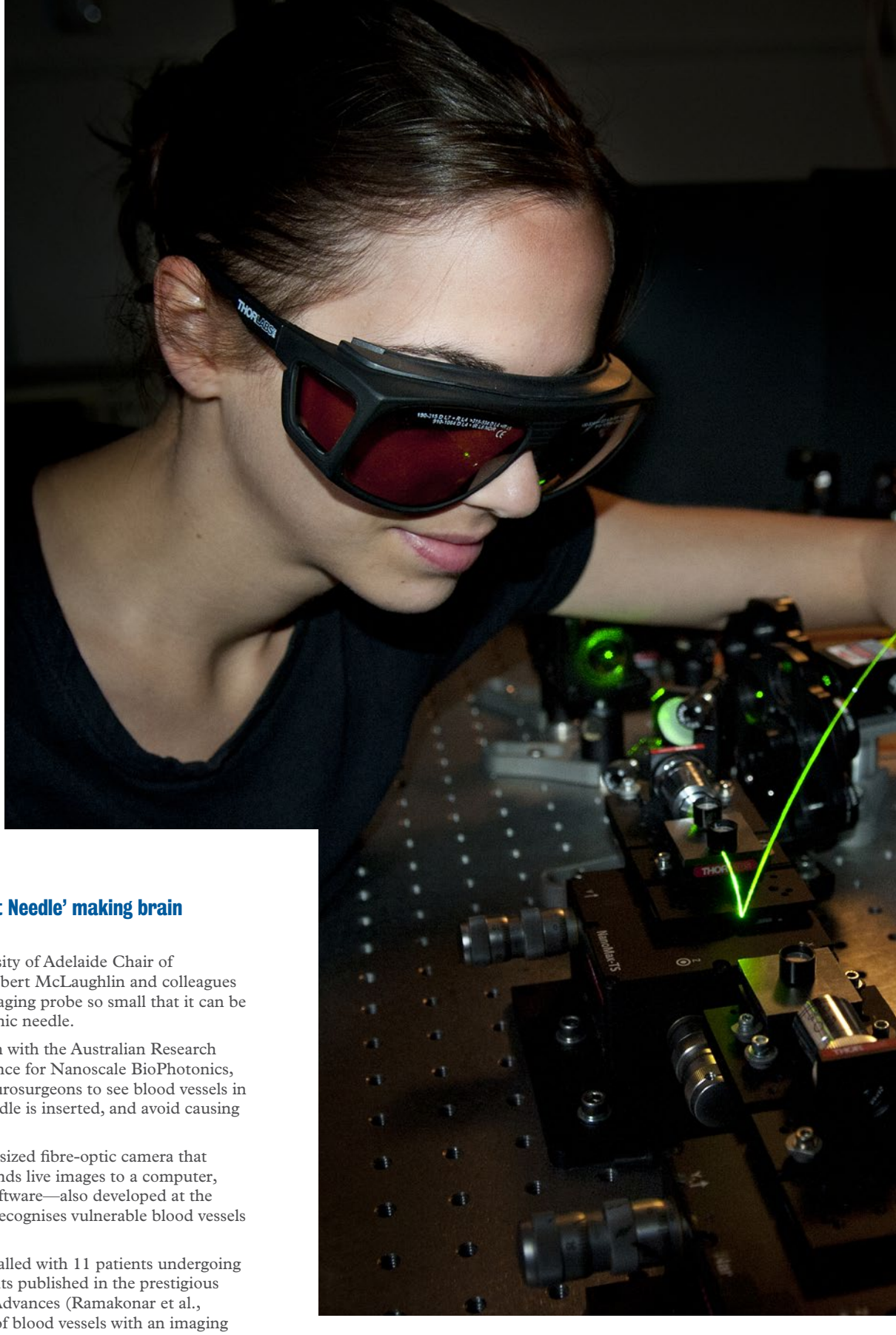
Developing new sensing technologies that push the boundaries of accuracy, sensitivity and sample volumes.

World's most precise clock boosting Australia's defence

Originally conceived by IPAS Director Andre Luiten and refined with institute colleagues, the 'Sapphire Clock' is 1000 times more accurate than any competing timekeeping technology.

Properly described as a cryogenic sapphire oscillator, it will lose or gain just one second every 40 million years; and it's giving the Australian Defence Force (ADF) a step-change performance improvement in one of our most vital national-security assets.

The remarkable device, which uses a synthetic sapphire crystal's natural resonance frequency to maintain a steady oscillating signal, is being integrated into the ADF's Jindalee Over-The-Horizon Radar Network (JORN). Its inclusion will enable the already world-leading network to identify targets that are smaller, further away and moving more slowly.



Groundbreaking 'Smart Needle' making brain surgery safer

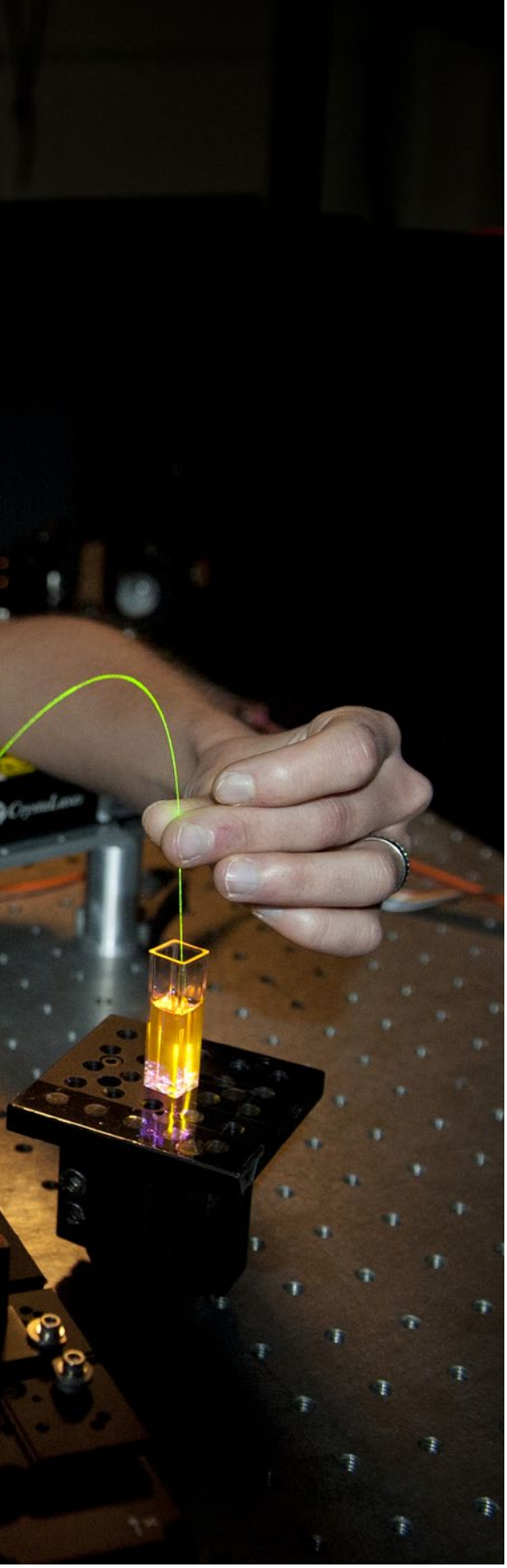
IPAS member and University of Adelaide Chair of Biophotonics Professor Robert McLaughlin and colleagues have developed a novel imaging probe so small that it can be encased within a hypodermic needle.

Developed in collaboration with the Australian Research Council Centre of Excellence for Nanoscale BioPhotonics, the technology enables neurosurgeons to see blood vessels in a patient's brain as the needle is inserted, and avoid causing potentially fatal bleeds.

The probe contains a hair-sized fibre-optic camera that shines infra-red light. It sends live images to a computer, where custom-designed software—also developed at the University—immediately recognises vulnerable blood vessels and alerts the surgeon.

The probe was recently trialled with 11 patients undergoing brain surgery and the results published in the prestigious scientific journal Science Advances (Ramakonar et al., "Intraoperative detection of blood vessels with an imaging needle during neurosurgery in humans," *Science Advances*, 4(eaav4992), 2018).

Patented in the USA and under examination in Europe, the transformational technology will be manufactured in South Australia by spin-out company Miniprobes Pty Ltd (see page 11).



Quantum Materials

Quantum materials and devices have led to a wide range of technologies with great societal and economic impacts, such as transistors and memory for computers, lasers for medicine and communications, light-emitting diodes for energy-efficient lighting, and devices for power electronics. The global market capitalisation of the semiconductor industry is valued at AU$550 billion per year, with an excepted growth exceeding AU$1.3 trillion by 2030.

Recognising the tremendous potential for a sovereign capability that will meet the growing need of Industry and Defence, IPAS has led the creation of a world leading ecosystem located in proximity with Lot Fourteen - South Australia's innovation precinct, Defence Science and Technology (DST), the Australian Space Agency (ASA) and Silanna, the largest semiconductor company in Australia's R&D facilities. This provides a unique opportunity to translate fundamental research discoveries into practical implementation in industries, laying the foundation required to build Quantum Technologies-based industry with a value exceeding of $1 billion in South Australia.

RESEARCH SPIN-OUTS

QUANTX LABS-CRYOCLOCK

QuantX Labs is the most successful start-up company spun out from IPAS. It was founded on the Institute's exceptional Sapphire Clock technology and is rapidly expanding into other areas including Quantum Sensing.

QuantX Labs aims to be the premier, sovereign provider of the highest precision timing and sensor products used in defence, space and critical infrastructure. The QuantX Labs team have more than 70 years combined experience in the invention and development of precision measurement devices. They have a "passion for precision" and believe that precision measurement is a major driving force for all human endeavour.

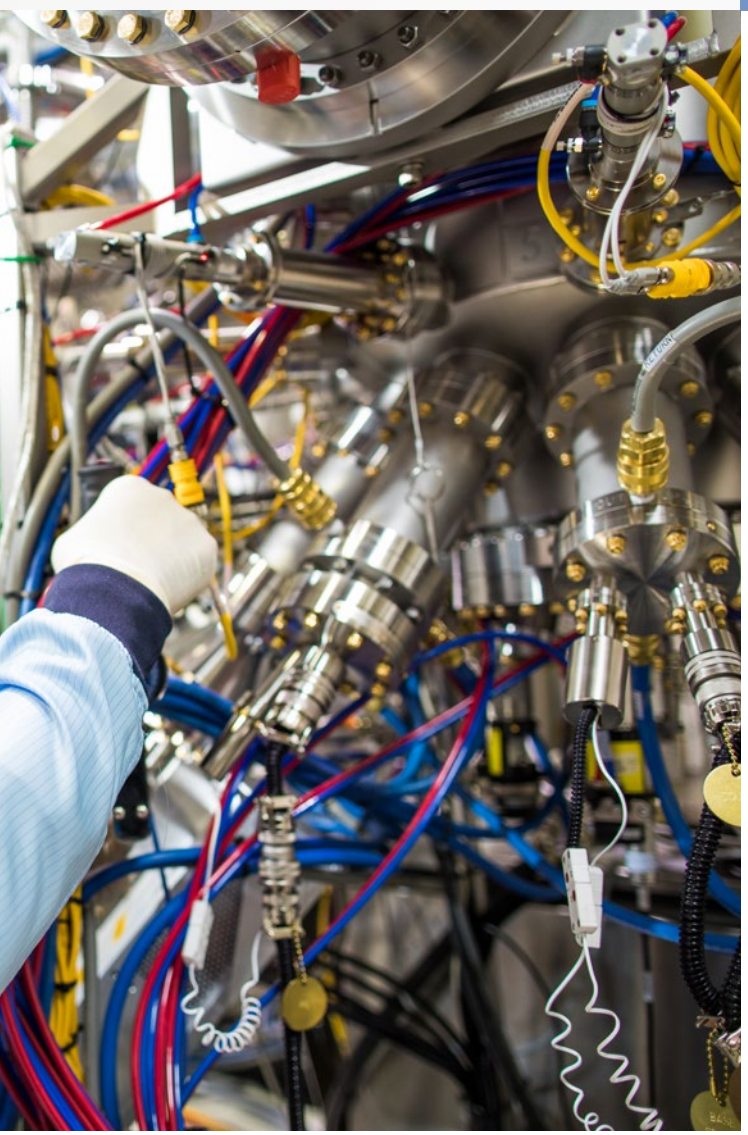
Cryoclock, their flagship product, is the world's most precise clock – thousands of times more precise than current timing, losing just one second for every 40 million years of operation. This leading-edge technology is just one of many being developed for a range of sovereign and global applications including Australia's Jindalee Operational Radar Network (JORN).

Their production and test facility, based at the Lot Fourteen Innovation precinct, is providing a unique sovereign industrial capability to support Australian Defence and Space programs in radar, sensing, quantum technology and timing/positioning networks.

MINIPROBES

Miniprobes Pty Ltd commercialises high-precision, low-cost optical scanning technologies developed at IPAS. The company's initial foci is in producing and distributing the Smart Needle - a handheld device ideally suited for the livestock industry.

The Smart Needle provides high-resolution imaging deep within tissue. It can quantify the microstructure of meat and measure intramuscular fat, which is a strong indicator of meat-eating quality. With seed funding from Meat & Livestock Australia, the company is working with researchers at IPAS to develop a product for meat processing plants. This has the potential to allow meat producers to rapidly identify premium meat product for local markets, and provide a guarantee of meat quality for Australian export markets.



3D METAL PRINTING

The IPAS Optofab Adelaide team established a state-of-the-art 3D metal printing facility in Edinburgh, with three state of the art Renishaw AM400 3D metal printers and ancillary equipment.

The University has partnered with Amaero International Limited (ASX:3DA), a world leader in metal additive manufacturing to run this facility as a commercial print bureau.

Amaero raised $18m in 2020 and the facility is now a key infrastructure in the Global Amaero organisation.

Amaero is a strategic partner of the University of Adelaide, working collaboratively to make Adelaide a leader in 3D printing research, education, training and manufacturing.

EZY-GLAS

EZY-GLAS Technology Pty Ltd, established in 2020, is commercializing eco-friendly coloured glass manufacturing technology developed at IPAS. The company's vision is to provide coloured glass products for use in glass art, printing and other high-value applications where product identity, safety and quality are prerequisites.

Compatible with commercial glass mass-production facilities, the technology employs non-toxic materials to impart any type of clear glass with unlimited colour choices and unique dichroic colour effect. The produced coloured glasses have been successfully employed by local glass artists at Jam Factory to make glass sculptures. The company is also exploring other market opportunities such as 3D glass printing, and coloured inks for scientific/medical instrument.

OUR PARTNERS

HOW WE CAN HELP

At IPAS we're striving to establish our institute as a thriving research-and-development hub for the local and broader photonics industry, and all who benefit from it. In doing so we seek to enhance our state's - and nation's - advanced manufacturing capabilities and global competitiveness, and create significant employment opportunities.

As part of this mission, we would be delighted to apply our capabilities in support of your own business's or organisation's goals. Partnering with IPAS will give you access to the world-class expertise and state-of-the-art facilities required to elevate your research and development to the next level.

So if you're ready to take that step, don't hesitate.

CONTACT US

Institute for Photonics and Advanced Sensing

Telephone: +61 (0)8 8313 9254
Email: ipasadelaide@adelaide.edu.au
Level 1, Braggs Building,
University of Adelaide, Adelaide, SA, 5005

Piers Lincoln
Institute Manager

Telephone: +61 (0)8 8313 5772
Email: piers.lincoln@adelaide.edu.au

Elodie Janvier
Strategic Research Development Manager

Telephone: +61 (0)8 8313 5132
Email: elodie.janvier@adelaide.edu.au

KAURNA ACKNOWLEDGEMENT

We acknowledge and pay our respects to the Kaurna people, the original custodians of the Adelaide Plains and the land on which the University of Adelaide's campuses at North Terrace, Waite, and Roseworthy are built. We acknowledge the deep feelings of attachment and relationship of the Kaurna people to country and we respect and value their past, present and ongoing connection to the land and cultural beliefs. The University continues to develop respectful and reciprocal relationships with all Indigenous peoples in Australia, and with other Indigenous peoples throughout the world.

FOR FURTHER ENQUIRIES

The University of Adelaide SA 5005 Australia

EMAIL ipasadelaide@adelaide.edu.au

TELEPHONE +61 (0)8 8313 9254

ua.edu.au/ipas

Published July 2021 UA30092-IL
CRICOS 00123M

SOUTH AUSTRALIA