



# CANBERRA:

THE NATIONAL  
HOME FOR THE  
AUSTRALIAN  
SPACE AGENCY



**ACT**  
Government





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CANBERRA



## A MESSAGE FROM THE **CHIEF MINISTER ANDREW BARR**

Canberra is currently the home of the Australian Space Agency – an important indication of the role the nation's capital will play as Australia builds a stronger presence in the international space industry.

Almost one in four Australian space sector jobs are already in Canberra. We are the home of the next generation of researchers, engineers and scientists that will support the future growth of the industry.

With the global space industry now worth AU\$420 billion per annum and growing by 10 per cent each year, the Australian Space Agency (the Agency) and the ACT Government can partner to ensure that the industry continues to create jobs.

Cover image: *UNA Sculpture*, 2013, Wolfgang Buttress, the Australian National University, Canberra.

Image credit: Atelier Red + Black.





The ACT Government has provided leadership in the national conversation over the last three years to develop the national space industry, working closely with South Australia, other states and the Northern Territory to promote industry growth.

There are clear advantages to having the Agency based here in Canberra. The Australian National Concurrent Design Facility at the University of New South Wales Canberra, combined with the Australian National University's National Space Test Facilities provides Australia's best capability to design, build and test spacecraft.

A number of leading private companies already run their space operations from Canberra, and links to key research and education institutions will enable these companies to provide the very best expertise to the Agency.

The ACT Government will continue working with the Agency and other state and territory governments to maintain a collaborative effort to the nation's presence in the global space industry. While this is appropriately a national effort, Canberra is the centre of policy development, and the research and partnerships with governments that will underpin this industry in the future.

# WHY CANBERRA?



"The Australian Space Agency will have as a prime objective the development and growth of the Australian space industry. While industry itself will be widely distributed across Australia, the bulk of Australian Government funds, space industry regulators, international customers and collaborators, and an overwhelming majority of government policies impacting the space industry, will come from Canberra. Proximity to those will be very important success factors for the Agency."

**Dr Ben Greene, EOS Space Systems**

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"The national leadership position of the ACT in astronomy and space research dates back to 1924 with the establishment of the Commonwealth Solar Observatory on Mount Stromlo. More than 90 years later, we are still leading Australia. As Australia's national university, we believe that there is no better place to locate the Australian Space Agency than Canberra - the national capital."

**Professor Brian Schmidt AC, Vice-Chancellor, The Australian National University**

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"In order for Australia to grow a vibrant domestic space industry sector, the Agency must rely upon world-class capability in diverse areas such as satellites and sensors, on-board and on-ground data analytics, ground infrastructure, and the inspiration and education activities necessary to develop a high-tech skills pipeline. The capabilities in the Canberra region lead the country in many areas. These will be of critical importance to the Agency."

**Professor Michael Frater, Rector, UNSW Canberra**

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"The success of the Australian Space Agency will in large part depend on its ability to work with the Department of Defence to implement the development of Australia's space defence capabilities as set out in the Defence White Paper. Given that Canberra is the national home for the Department of Defence, the national security agencies and key government agencies with an interest in space, Canberra is the only logical home for the Australian Space Agency."

**Air Marshal (ret'd) Geoff Brown AO, Chair, ACT Defence Industry Advisory Board**

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"The co-location of the Australian Space Agency with the Department of Defence will provide significant opportunities for the commercialisation of Australian space technologies. Companies like SkyKraft are already benefiting from the Defence White Paper's commitment to the growth of Australian space capabilities."

**Air Vice-Marshall (ret'd) Mark Skidmore AM, Chair, Skykraft Pty Ltd.**

## CANBERRA IS A HUB FOR CORE SPACE AGENCIES AND ORGANISATIONS

The core business of the Agency will revolve around policy coordination between Commonwealth departments and agencies and an increasingly complex set of international relationships. Except for the Bureau of Meteorology, which is located in Melbourne, every other major Commonwealth stakeholder is based in Canberra.

Space policy is linked inextricably to national security policy – through the Department of Defence, the Department of Foreign Affairs and Trade and elements of the national intelligence community. The ‘dual use’ nature of many space technologies means that even seemingly benign civil and commercial initiatives are likely to require coordination with the national security community. Conversely, as the national security community seeks to develop space capabilities it will need civil and commercial assistance in ways not envisaged or used in the past.

Assured and secure access to the services and data provided by satellites is essential to all sectors of the economy. Space is not a specialist function that can be performed away from the centre of power. Space is core business of the Commonwealth, and this is a compelling reason for the Agency to be headquartered in Canberra, at the heart of Australia’s Government operations.

This does not mean that every facet of the space sector needs to be, or should be, located in Canberra. Near equatorial space launch, for example and by definition, should occur in northern Australia. Victoria has an advantage in the provision of Science, Technology, Engineering and Mathematics (STEM) education to primary and secondary school students, South Australia has advantages with defence industry, and Western Australia, because of mine automation, has advantages in robotics. The ACT Government advocates for a collaborative approach to the growth of our space industry, which enhances and engages with the specific strengths of each state and territory.



## CANBERRA’S SPACE ECOSYSTEM IS WELL DEVELOPED AND CAPABLE OF SUPPORTING THE FUNCTIONS OF THE AGENCY

There is expertise across most aspects of space activity in government, industry and the research sectors and, perhaps more compellingly, there is already a great deal of cross-sector and cross discipline cooperation and collaboration. In short, these previously diverse interests are beginning to coalesce and self-identify as belonging to and being part of a national space industry. The location of the Agency in the ACT will allow it to leverage these existing collaborative relationships.

## INTERNATIONAL ENGAGEMENT

An important role for the Agency will be to support Australia’s commitments under the five United Nations (UN) Space Treaties and to lead negotiations regarding bilateral and international civil space and technological safeguard agreements.

More than 80 embassies and high commissions are located in Canberra. These will be the first ports of call by Agency staff as they work to support Australia’s international obligations, and to achieve the international objectives that have been set for the Agency.



# THE IMPORTANCE OF THE AGENCY

The ACT has high expectations of the Agency as does the Commonwealth and other jurisdictions. We recognise the dependency that all facets of the economy have on secure and assured access to the services and data provided by satellites.

Satellite systems, irrespective of their owners and operators, may be regarded as virtual critical infrastructure of regional, national and global significance. As the Agency builds its reputation and networks internationally, it will contribute to the resilience of all sectors of the Australian economy.

The ACT recognises the enormous development opportunities that exist as space technologies become more affordable and open to new entrants into a field that, until recently, has been the almost exclusive preserve of a very few nations.

A principal task of the Agency is to create a governance, policy and investment environment that will lead to the domestic space workforce

doubling in size from 10,000 to 20,000 people by 2030, and to the national space economy trebling from AU\$3-4 billion to AU\$10-12 billion in the same period. These are modest but achievable goals in the context of the global industry now worth AU\$420 billion per annum and growing by 10 per cent each year.

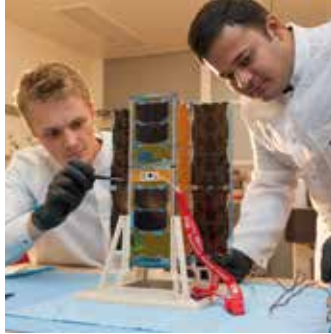
The Agency's fundamental role is to create a national ecosystem with close links to the international space community, that encourages private sector investment in companies that will deliver space-related products and services in Australia with, wherever possible, an export orientation as well.

Although the focus of the Agency is to support civil space activities, the Commonwealth recognises that many space technologies are 'dual use' in nature – having both civil and military applications. The Agency's success will be determined, in no small measure, by the way in which it engages Defence and the national security community more broadly in its activities.

Australia's location and size combine with its alliance relationships and commitment to the international rules-based order, to provide a unique and providential set of circumstances that favour development of a domestic space industry. Australia needs to position itself to take full advantage of the changing nature of the sector enabled by new and emerging technologies including robotics, advanced manufacturing, big data analytics, advanced communications and the miniaturisation of electronics.







## OUR COLLABORATIVE APPROACH

The ACT Government has worked hard to bring a national focus to the space debate. This includes formal representations to the Council of Australian Governments (COAG) Industry and Skills Council, direct advocacy to the Prime Minister and portfolio Ministers, and the development of a tripartite Memorandum of Understanding (MoU) signed by the ACT, South Australia and Northern Territory governments to advocate for a national approach to sector development.

Three years ago, the ACT Government made a commitment to work with our higher education institutions and industry to support the development of the space sector in Australia.

Between 2016 and 2018, the ACT Government provided \$1 million to the University of NSW Canberra (UNSW Canberra) and the Australian National University (ANU) to strengthen Canberra's space sector.

Going forward, to support the space industry and other key sectors in the ACT, the ACT Government is investing \$9 million over the next three years in stimulus and innovative infrastructure projects under the Priority Investment Program.

### CASE STUDY: ACT GOVERNMENT FUNDED SPACE PROJECTS

#### THE ANU - NATIONAL SPACE TEST FACILITIES

ACT Government funding of \$250,000 has enabled free access to the largest space test facilities in the country specifically to the national industry community, adding to the existing open access for research and defence groups. This recent award has created much interest from industry all over Australia, especially start-ups and potential launch providers.

#### UNSW CANBERRA - SPACE MISSION DESIGN FACILITY

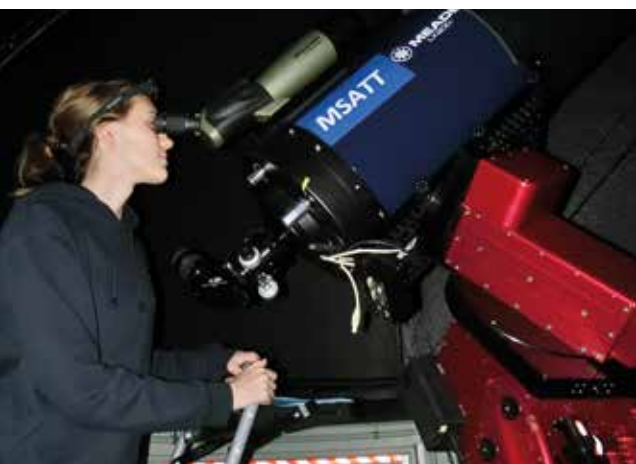
ACT Government funding of \$375,000 helped to establish a space mission design facility to bring together industry, agencies and the research sector to rapidly design and validate the technical and economic viability of space missions. The facility is the first of its kind in Australia.

#### UNSW CANBERRA AND ANU - SPACE BASED QUANTUM COMMUNICATIONS

In 2016-17 the ACT Government funded a consortium comprising of Quintessence Labs (QLabs) and Liquid Instruments, ANU and UNSW Canberra to establish and demonstrate a pathfinder quantum ground station for satellite crypto-communication.

The project has now sparked interest from the US Air Force Research Labs.





## BUILDING A SKILLED WORKFORCE PIPELINE

Through our high quality education system, government and industry supported STEM and entrepreneurship outreach initiatives, Canberra is working collectively to build a workforce pipeline to support the growth of our businesses.

Dedicated space programs are engaging and inspiring the next generation of space scientists and professionals. These programs include the YMCA Canberra Space Squad - a program promoting space careers to students in years 7 to 9 and the MSATT - Canberra's first astronomical teaching observatory for school students.

### **CASE STUDY: MSATT**

MSATT is Canberra's first astronomical teaching facility for school students in years 9 to 12. MSATT provides students with the opportunity to operate a professional grade telescope, collect and analyse their own astronomical data and prepare formal refereed reports on their findings. The project is the brainchild of ACT Education Science teacher Geoff McNamara AM, who won the 2014 Prime Minister's Prize for Excellence in Science Teaching in Secondary Schools.

## SPACE CAPABILITIES IN THE CANBERRA REGION

Central to Canberra's space industry development is an ecosystem of innovative and commercial participants across a broad spectrum of roles, from government, industry, education institutions and the research community.

In 2017, the ACT Government launched the Canberra Region Space Industry Capability Directory, available at [www.act.gov.au/space](http://www.act.gov.au/space). The site lists capabilities and profiles of Canberra-based space companies such as Q-Labs, Liquid Instruments, Locata, SHOAL, EOS, Geoplex, Geospatial Intelligence, Clearbox, Nova, Equatorial Launch Australia, Via Sat, Lockheed Martin, Airbus and Northrop Grumman.

It is estimated nearly one in four Australian space industry jobs are located in the Canberra Region, providing expertise and capabilities in communication technologies and services, satellite ground stations, space situational awareness and debris monitoring, earth observation satellites and services, positional navigation and timing infrastructure, spatial technology and support services, research and development, and education and training.

# COMMUNICATION TECHNOLOGIES & SERVICES, SATELLITE GROUND STATIONS & DEEP SPACE COMMUNICATIONS NETWORK GROUND STATIONS

Through our infrastructure, higher education institutions, companies and Australian Government agencies, Canberra will continue to support Australia in expanding its role as a global partner in communications for human space missions, satellite command and control, and the tracking of satellites.

Canberra has supported the National Aeronautics and Space Administration (NASA) for the command, telemetry, uplink/downlink and communications related to deep space missions for more than 50 years across the Honeysuckle Creek, Ororal Valley and Tidbinbilla tracking stations. The Canberra Deep Space Communication Complex (CDSCC) at Tidbinbilla is one of only three NASA Deep Space Network facilities in the world, which currently supports more than 30 active deep space missions.

The ANU and UNSW Canberra both have satellite operation capabilities with ground station infrastructures to support satellite missions.

## **CASE STUDY: NASA-CDSCC SPACE TRACKING TREATY**

In 2017, the Australian Government concluded a new Space Tracking Treaty with the USA which will run to 2043. The estimated value of this treaty to the ACT economy is approximately \$375 million over that period.



# SPACE SITUATIONAL AWARENESS (SSA) & DEBRIS MONITORING

Canberra has world-class facilities and expertise in Space Situational Awareness (SSA) and debris monitoring to support the growth of the Australian space industry. With approximately US\$900 billion worth of satellites in orbit currently, which are vulnerable to loss or significant damage through collisions with space debris, capabilities in SSA and debris monitoring present a significant economic opportunity for Australia.



## CASE STUDY: EOS SPACE SYSTEMS

EOS Space Systems, a Canberra-born and bred company, is a global leader in space situational awareness and debris monitoring. EOS Space Systems manages and operates a number of Satellite Laser Ranging (SLR) telescopes at the ANU Mount Stromlo Observatory. This facility provides surveillance of space assets including the automated tracking of operational satellites and space debris. The Stromlo facilities remotely control a further four Satellite Laser Ranging (SLR) telescopes located in Learmonth WA. Using high powered 'eye safe' laser systems, EOS can track and catalogue satellites as well as the most potentially damaging pieces of debris.

EOS Space Systems plays a critical role in Australia's contribution to the global SSA effort, providing laser tracking from the ANU Mount Stromlo Observatory and Learmonth that complements the capabilities of USAF C-band radar and the US DARPA Space Surveillance Telescope at Exmouth in West Australia.

## CASE STUDY: THE SPACE ENVIRONMENT RESEARCH CENTRE

The Space Environment Research Centre (SERC), a \$20 million research facility located at the ANU Mount Stromlo Observatory, is a partnership between Canberra-based company EOS Space Systems, the ANU, RMIT University, Optus Satellite Systems, Lockheed Martin and the Japanese National Institute of Information and Communications Technology.

SERC brings together leading debris mitigation programs from around the world to create a team to address the problem of space debris. The scientific advances made by SERC contribute significantly to SSA by improving the accuracy of tracking objects in space, predicting their orbits and improving space object management capabilities.





## POSITIONING, **NAVIGATION & TIMING** INFRASTRUCTURE

Geoscience Australia's Satellite-Based Augmentation System (SBAS), National Positioning Infrastructure Capability (NPIC), and Digital Earth are all managed in Canberra. Digital Earth is also supported by the National Computational Infrastructure at the ANU in Canberra.



## **EARTH** **OBSERVATION** SERVICES

Canberra has a long history with the provision of earth observation service capabilities through the integration of satellite imagery data into spatial applications.

Airbus Defence & Space Office, responsible for the dissemination of earth observation satellite imagery, is headquartered in Canberra.

As a Canberra based small to medium enterprise (SME), Geospatial Intelligence is at the forefront of delivering timely information that has been derived from satellite imagery.



## **LAUNCH** **SERVICES**

The head office of Equatorial Launch Australia (ELA) is located in Canberra.

ELA has worked, and continues to work, patiently and carefully with a raft of Commonwealth departments and agencies to obtain the necessary clearances and approvals in order for it to establish a spaceport on the Gove Peninsula in Arnhem Land in the Northern Territory.

# DEFENCE & UNSW CANBERRA COLLABORATION

Defence and national security interests will provide considerable opportunity for Australia's space industry. In the 2016 Defence White Paper (DWP), the Australian Government committed to investing in modern space capabilities.

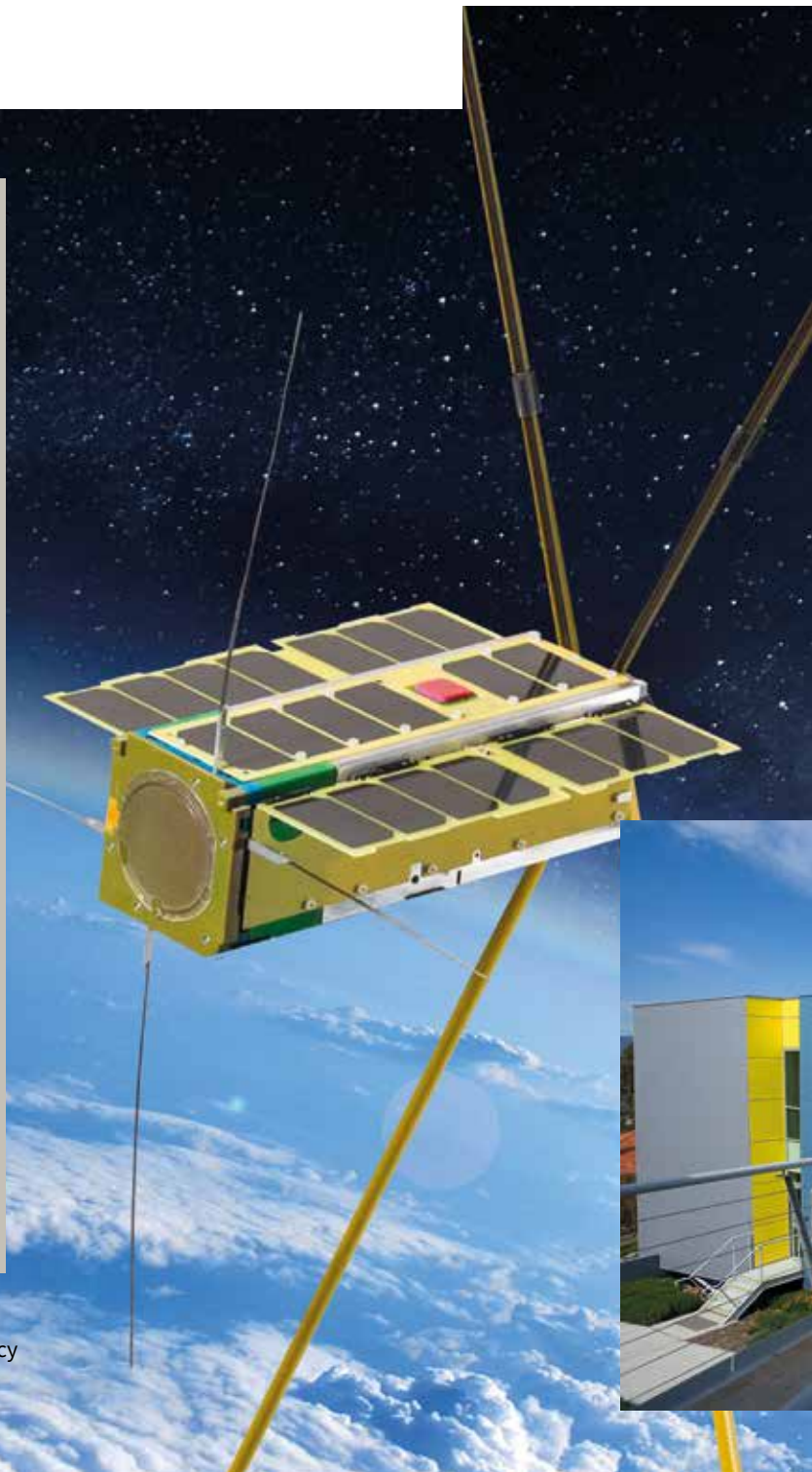
Over the next two decades, Defence will invest nearly AU\$10 billion in space-related projects, including the acquisition of major systems, as well as associated project management, sustainment capability and personnel.

## CASE STUDY: BUCCANEER CUBESAT AND SKYKRAFT

The recent launch of the Buccaneer Risk Mitigation Mission CubeSat through a partnership between UNSW Canberra Space and the Defence Science and Technology Group, and the current development by UNSW Canberra Space of three small spacecraft under a AU\$10 million contract from RAAF, shows the importance of government-supported space missions to grow national and industry capability.

The research work has resulted in the formation of Skykraft Pty Ltd, a jump-start company from UNSW Canberra. Skykraft is uniquely positioned to leverage the skills and experience developed through UNSW Canberra Space. Its goal is to commercialise those capabilities for civil and defence space requirements and to provide space-enabled actionable information.

This is a textbook example of the Commonwealth's innovation agenda and 'jobs and growth' aspirations being realised.







## RESEARCH EXCELLENCE

The research and innovation needed to underpin Australia's growing space industry is being actively provided by Canberra's educational and research institutions. UNSW Canberra and the ANU are the most active higher education institutions in space-related disciplines in Australia.

Together, these two institutions provide Australia's only end-to-end capability for conceptualisation, design, build, test and operations of Australia's next generation of satellites, through state-of-the-art facilities at ANU's National Space Test Facilities and UNSW Canberra's National Space Mission Design Facility.

## THE AUSTRALIAN NATIONAL UNIVERSITY

The ANU has established strengths in space research and development, which reach across sciences, law, business, ethics and policy. The University is committed to fulfilling its role as a national resource for the space industry.

ANU Professor Christine Charles has led long-running research into plasma propulsion for spacecraft, while ANU physicists and engineers are contributing to the laser range-finding instruments for a space mission led by NASA and the German Space Agency DLR.

ANU is also partner in the Giant Magellan Telescope project and has collaboration agreements with the European Southern Observatory, as well as close associations with leading research institutions and space agencies around the world.

### CASE STUDY: ANU'S NATIONAL SPACE TEST FACILITIES

The National Space Testing Facilities provide a national space environmental test facility to support research, and government and commercial projects. The facilities include a Space Simulation Chamber, Vibration and Shock, Class 10,000 Cleanrooms, Anechoic Chamber and opto-mechanical test facilities. The facilities and staff can support the manufacture and test of an instrument or satellite up to 50kg.

Since officially opening in 2014, the facilities have supported the testing of four nano-satellites and the manufacture and test of adaptive optics systems.





# CANBERRA'S SPECIALISED SPACE CAPABILITIES

Canberra is already leading in many of the disruptive technology areas identified by the Expert Reference Group as our niche 'swim lanes' capabilities where Australia can leapfrog into areas of future competitive advantage.



## UNSW CANBERRA SPACE CENTRE

UNSW Canberra is taking the lead in developing end-to-end space capability including education and training, research and development, space mission design and manufacturing, test and evaluation and in-orbit operations. This capability has been achieved through a \$10 million direct investment by UNSW Canberra, plus a further \$10 million through a Research Agreement with the Royal Australian Air Force (RAAF). The combined investment into UNSW Canberra Space has created Australia's most significant space capability with 44 full time employees across 50+ academics, engineers, postdoctoral researchers and PhD students, many of whom have previously worked on 'big space' programs led by NASA, ESA and other international space entities.

## CSIRO CENTRE FOR EARTH OBSERVATION

Recently launched, the CSIRO Centre for Earth Observation (the Centre) headquartered in Canberra will coordinate a range of Earth-observing activities within CSIRO. The Centre will be a catalyst for engagement with Australian businesses, government agencies and research organisations.

## THE NATIONAL COMPUTATIONAL INFRASTRUCTURE AUSTRALIA

The National Computation Infrastructure (NCI) Australia based in Canberra at the ANU is the nation's fastest supercomputer, highest performance research cloud, fastest file system and largest research data repository.

## RADIO AND RADIO ANTENNAE CAPABILITY

CEA Technologies, a Canberra born and headquartered company, has world-first capability in active phased array radar technology. This capability has been mandated by the Australian Government for use in the Future Frigates program.

CEA Technologies has a five-year research and development agreement with the Defence Science and Technology Group to develop new solutions for future requirements in radar, communications, and electronic warfare.

## QUANTUM COMMUNICATIONS & TECHNOLOGIES

The ANU hosts a node of the ARC Centre of Excellence for Quantum Computation and Communication Technology, and the Centre for Gravitational Physics, which is pioneering gravitational wave astronomy within the international LIGO consortium. Successful commercial enterprises that have emerged out of the ANU include Quintessence and Liquid Instruments.

### CASE STUDY: QUINTESSENCE LABS

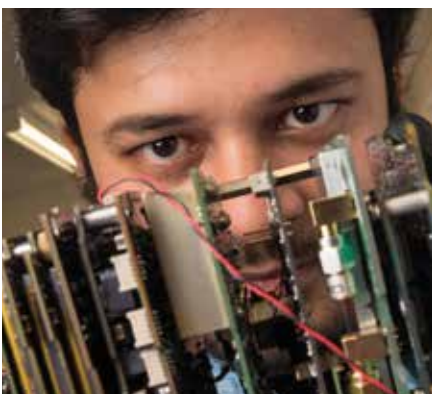
In 2017, Canberra-based Quintessence Labs was awarded a \$3.26 million investment from the Defence Innovation Hub, a part of the Australian Department of Defence, to continue the expansion of its quantum key distribution capabilities and extend it to free space communications. This was the largest of eight investments recently made by the Innovation Hub. Quintessence Labs recently won the World Economic Forum Technology Pioneer award, the only Australian Company awarded this honour.

## ASTRONOMY, PLANETARY SCIENCE AND EARTH OBSERVATION

The ANU is home to the Mount Stromlo and Siding Springs Observatories and the world-leading ANU Research School of Astronomy and Astrophysics (RSAA), where Professor Brian Schmidt AC conducted his Nobel-Prize winning research into the expanding Universe.

## ARTIFICIAL INTELLIGENCE IN SPACE 2.0

UNSW Canberra will lead the proposed ACT node of the CRC for Smart Satellites, and will be joined by the ANU and other Canberra region players. In particular, UNSW Canberra Space will lead the intelligent satellite systems theme of the Centre. This work will apply the disruption of artificial intelligence to the agility of Space 2.0 space systems in order to open up new opportunities for Australia to lead in global developments and attract a proportion of the global space economy.







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