



Space, Infrastructure and
Opportunities for research,
learning and teaching

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Image credit: Reddit u/finfondler



○ Astronomy, Spacecraft Tracking and Space Domain Awareness

- Only University in the world to operate a continental-scale radio telescope array with antennas :
 - Hobart (TAS) 26m and 12m antenna
 - Bidee Tier (TAS) 7.3m antenna and 1.3m optical tel.
 - Ceduna (SA) 30m antenna
 - Katherine (NT) 12m antenna
 - Yarragadee (WA) 12m antenna
- Collaborate with Geoscience Australia on Australia's PNT (position-navigation and timing) infrastructure.





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Time lapse of the Mt Pleasant 26m antenna during a geodetic VLBI observation 21 July 2020. Video by Benjamin Alldridge



○ Big Infrastructure

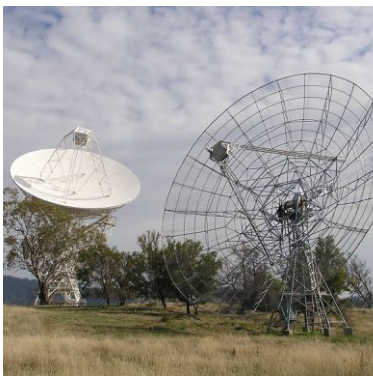
Pros:

- Impactful research opportunities
- Unique authentic learning experiences

Cons:

- Grant funding generally doesn't cover the full cost of research
- Long-term commitment





PHOTOGRAPH: BELL INGRAM/NASA

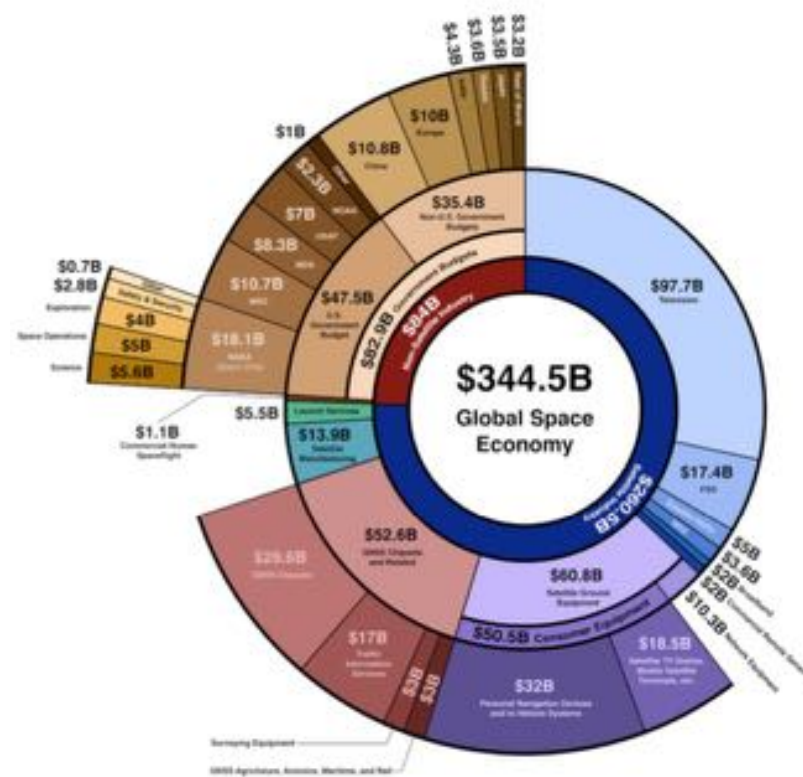


Image: Global Space Industry Dynamics report on industry.gov.au website

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The real logo of the Australian Space Agency

Learn more about Australian Research & Scientific Exploration



Now is the time for Australia to explore the depths & mysteries of our universe. We must go forth with agency and discover the undiscovered.

Spaceaustralia.com.au is a joke/paradody space agency site



Australian Space Agency

Australia was the seventh nation to launch a satellite (29 November 1967) and only the third nation to launch from its own territory.

But for much of the last 50 years the idea of an Australian Space Agency has been treated as something of a joke.

The Australian Space Agency was created on 1 July 2018. Its not aiming to be NASA or ESA, its focus is on building the capability of the Australian Space Industry.



The landing of the side boosters from the Falcon Heavy demo launch (Image: teslarati.com)



The Rocket Lab's Electron launch (Image: nasaspaceflight.com)

Space is changing

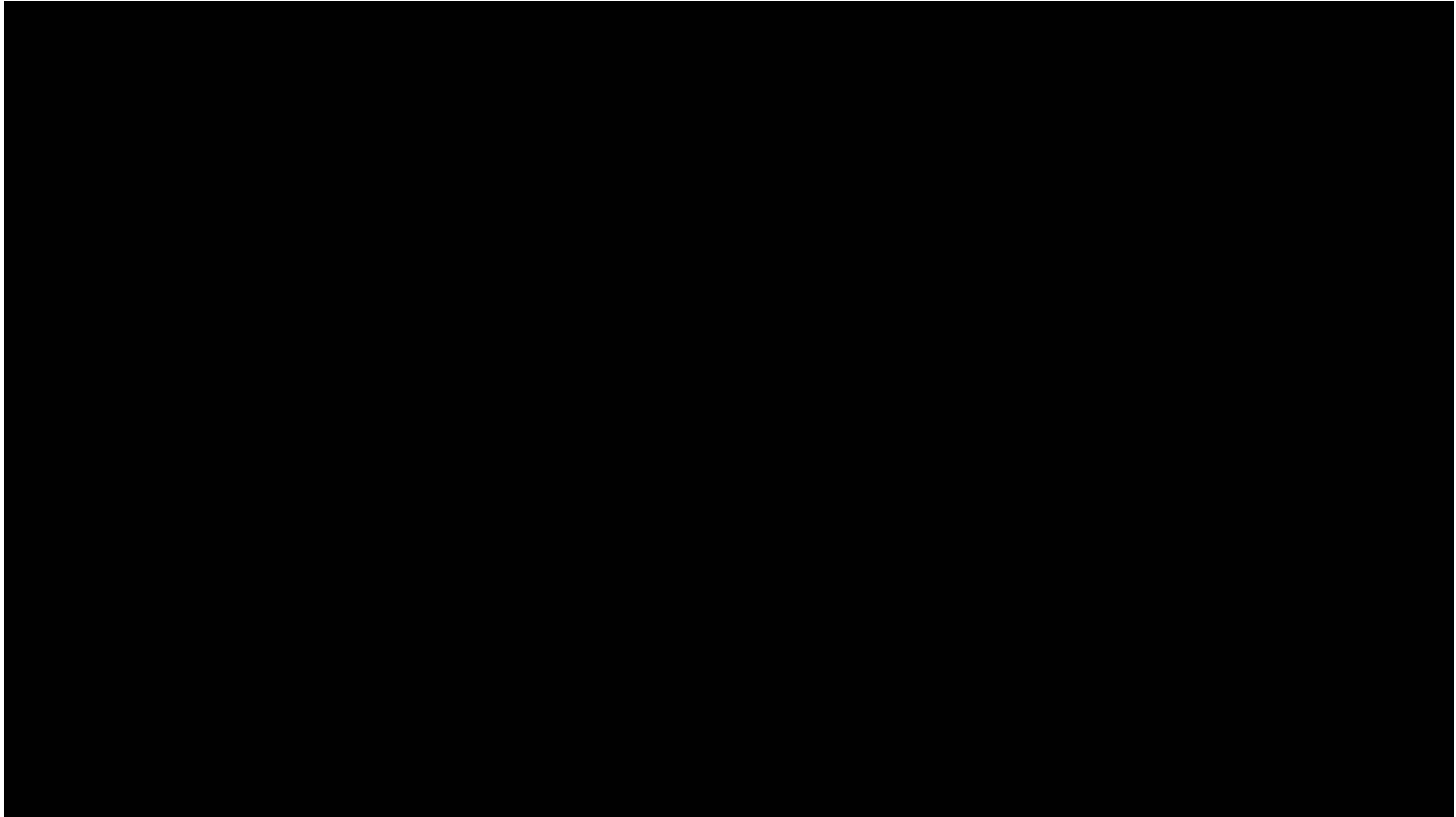
Space is no longer just for superpowers, aspiring superpowers and multinational corporations.

Commercial operators are reducing the cost of satellite launches.

Data provided by spacecraft is increasingly economically important.

Space is becoming rapidly more important for both commercial and strategic reasons.





Time lapse of the construction of the 7.3m ground station at the Greenhill observatory. This antenna will be used for up/downlink for low-earth orbit satellites and for space domain awareness.





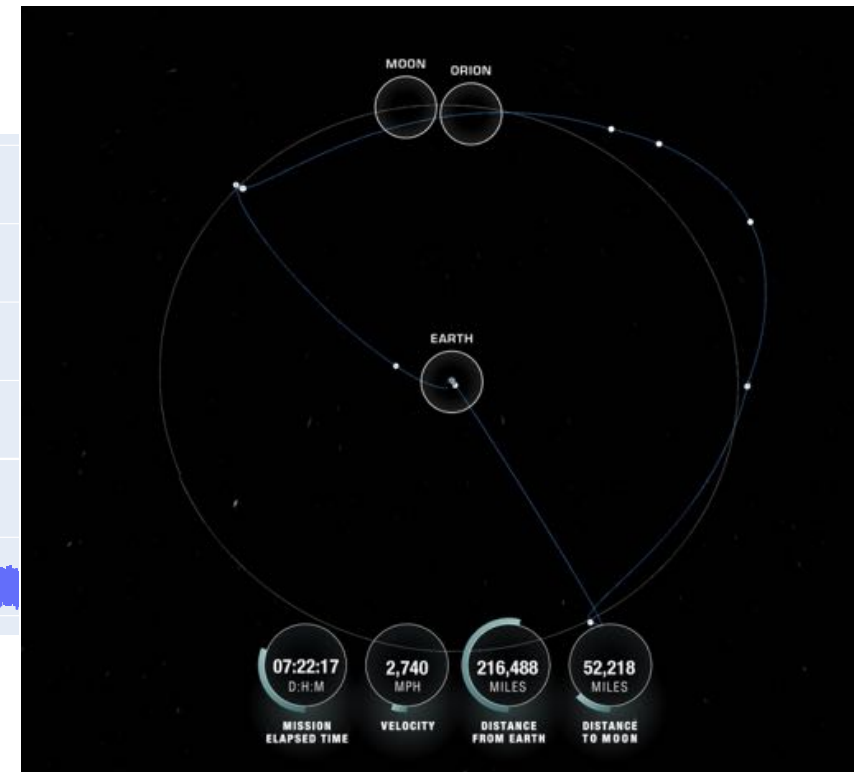
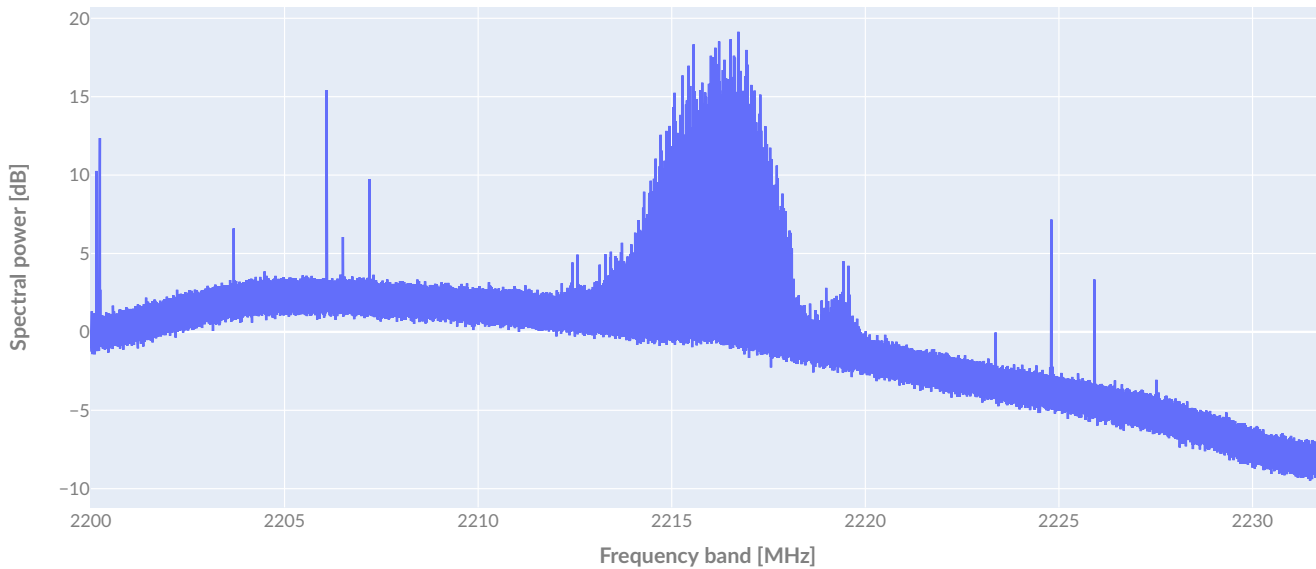
Identified Commercial Opportunities



- Communication to objects at Lunar/cislunar distances and beyond requires antennas with sizes $> 20\text{m}$. There are few of these in Australia:
 - The University of Tasmania owns/operates two such antennas which are geographically separated
- Space Domain/Situational Awareness (SDA) is of growing commercial and strategic importance. Australia has natural geographic advantage, there are opportunities to apply astronomy techniques
 - We can provide sensor capability at higher frequency, higher sensitivity, higher precision than other options.

- Observation of the Artemis-1 mission with the University of Tasmania Katherine 12m antenna. NASA's Orion spacecraft is transmitting at its maximum data-rate of 4 Mega samples per second. This data was collected from the spacecraft while it was in a Lunar orbit at a distance of more than 300 thousand km.

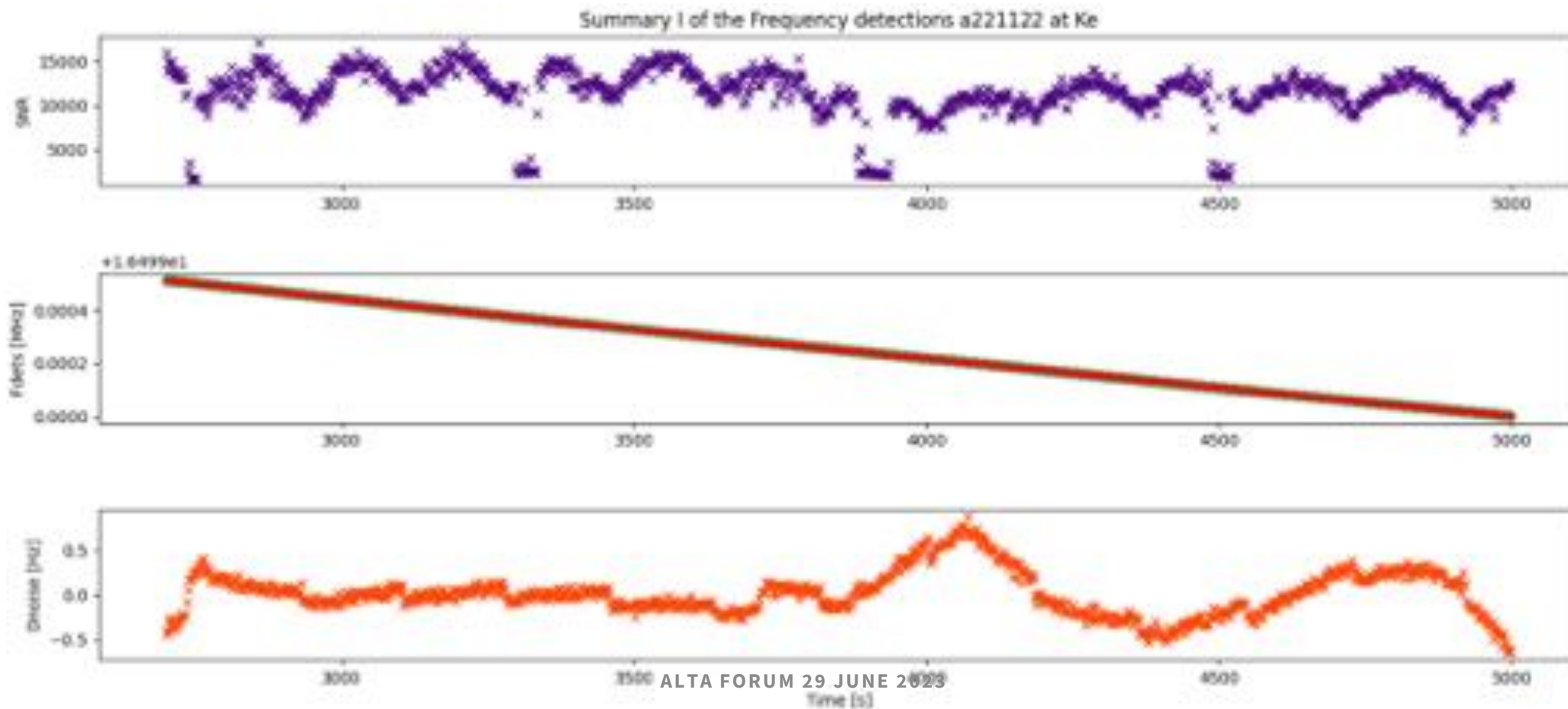
Normalised power spectra from ARTEMIS1 on 2022.11.24 at Ke
The satellite was observed at S-band



The transmission mode changes over time:

- A – Periodic variation (~150 seconds) on the intensity of the signal received, could be caused by tumbling or spacecraft spinning on its axis.
- B – Periodic drop in the Signal-to-Noise ratio every 500 seconds – intentional change in communications mode

Plots -> Up (Carrier to Noise ratio), middle (Doppler measurement 2216.49 MHz), Down (Doppler frequency - regression line). Time since the start of the data recording





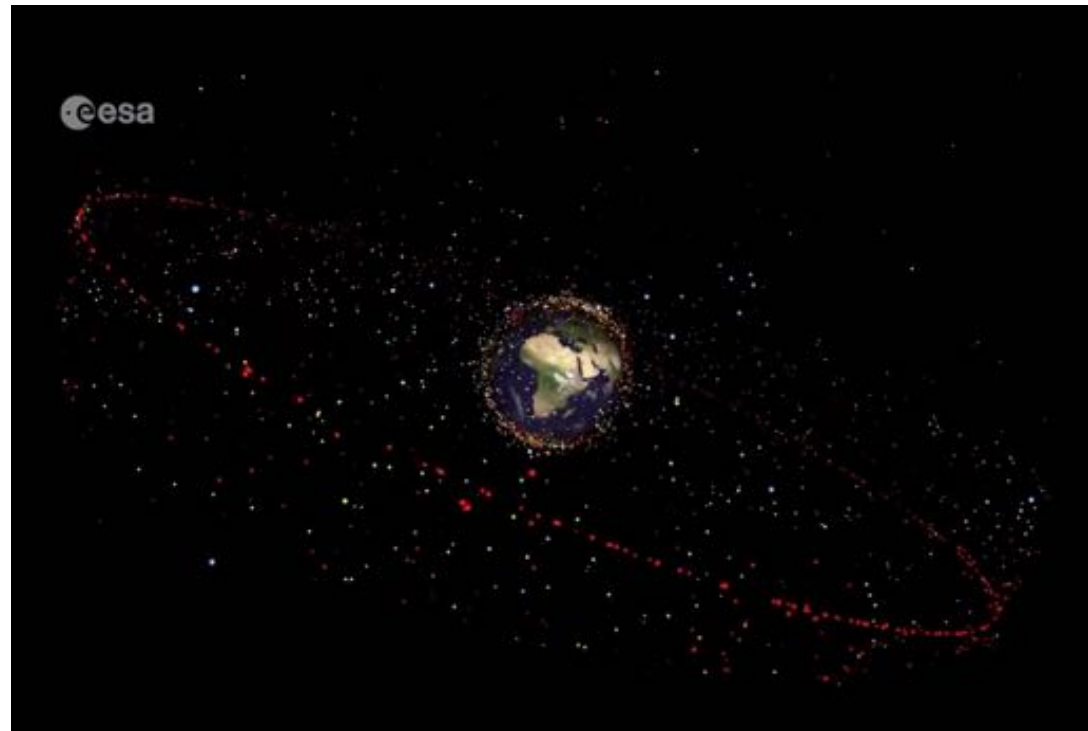
Space Domain Awareness

There are around 7500 active satellites currently in space and more than 25 000 objects softball-sized or larger (much of it “space junk”).

We’re launching more satellites every year (currently >1000/year).

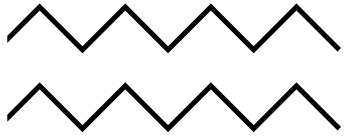
We need a lot more ground stations for communication.

Space Domain Awareness needs both new sensors and new data approaches



Objects in orbit with size more than 1 m (Image: ESA)





The Future?

There are many opportunities for both research and industry engagement in space.

The disruptions of commercial players on launch and communications are obvious, but there are many others which are less high profile.

