What is the Virtual Observatory?

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The ODC received grant funding from the Australian Government through the National Collaborative Research Infrastructure Strategy (NCRIS), via Astronomy Australia Ltd (AAL).

Milky Way over the Pinnacles in Australia - Michael Goh

What is the Virtual Observatory?

Put simply:

The Virtual Observatory is a vision of standardised ways to find, access and share astronomical data

International Virtual Observatory Alliance

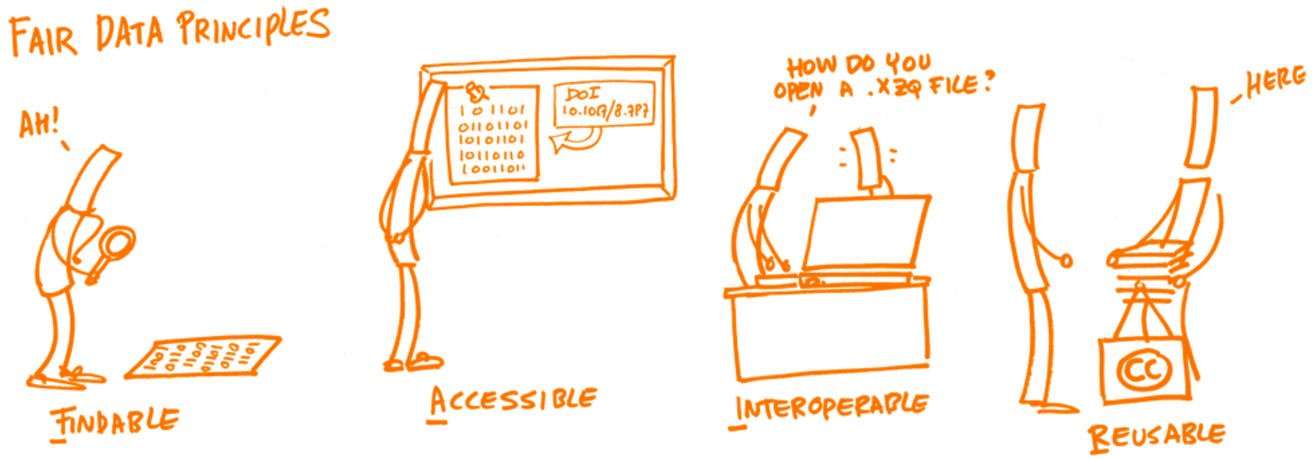
- The body that helps to enable the vision is the IVOA
- Founded in 2002 – Australia is a founding member
- The IVOA develops standards and protocols that are then implemented by observatories and other holders of data
- These standards have significant overlap with the FAIR principles

What are the FAIR Principles?

The “FAIR Guiding Principles for scientific data management and stewardship” were published in 2016 by Wilkinson et al.

Data should be:

- **F**indable
- **A**ccessible
- **I**nteroperable
- **R**eusable

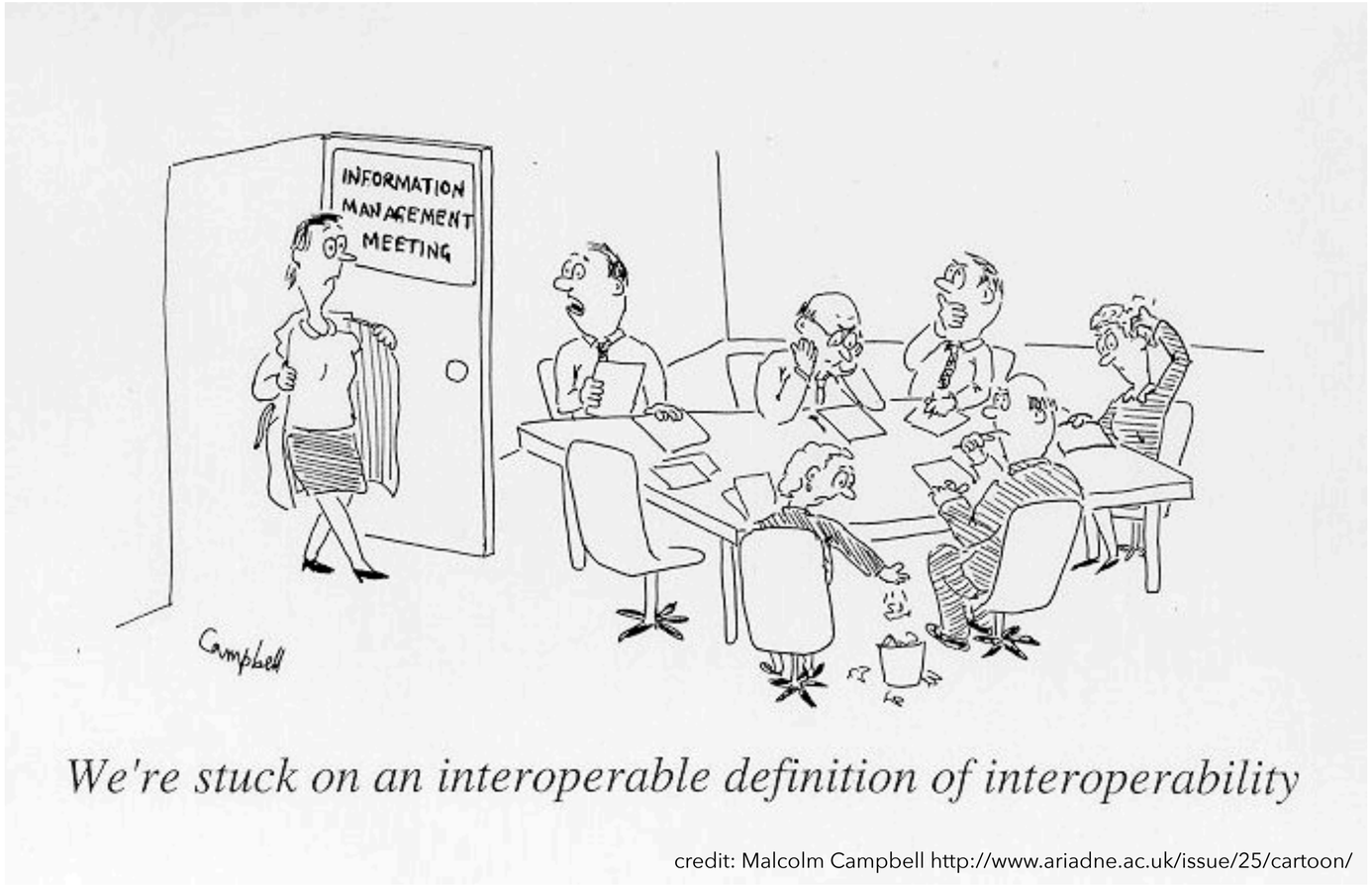


https://www.fosteropenscience.eu/learning/assessing-the-fairness-of-data/

How easily can your data be discovered?

How easily can your data be obtained?

How easily can your data be compared?



credit: Malcolm Campbell http://www.ariadne.ac.uk/issue/25/cartoon/

How easily can your data be trusted?

Why publish your data in the Virtual Observatory?

The Virtual Observatory makes your data:

- More valuable
- Easier to find for all researchers
- Easier to combine and integrate with other distributed datasets

Making data more accessible and easier to find encourages more people to get involved in STEM…

For example:

ZOONIVERSE

How can I access these services?

Tools like

- pyVO (affiliated astropy package): https://pyvo.readthedocs.io/
- Aladin Desktop: https://aladin.u-strasbg.fr/AladinDesktop/
- TOPCAT: http://www.star.bris.ac.uk/~mbt/topcat/#install

act as clients to query VO services

The Data Central Data Aggregation Service queries **multiple** services: https://das.datacentral.org.au

Data Aggregation Service

Common misconceptions about the VO

1. The Virtual Observatory failed
   - INCORRECT: almost all major observatories offer VO-compliant services
2. There's no data in the Virtual Observatory anyway
   - INCORRECT: there are many petabytes of data, including from ESO, ESA and NASA space missions, ASKAP, MWA, AAT, etc

The chances are you've used a VO service without even realising it!

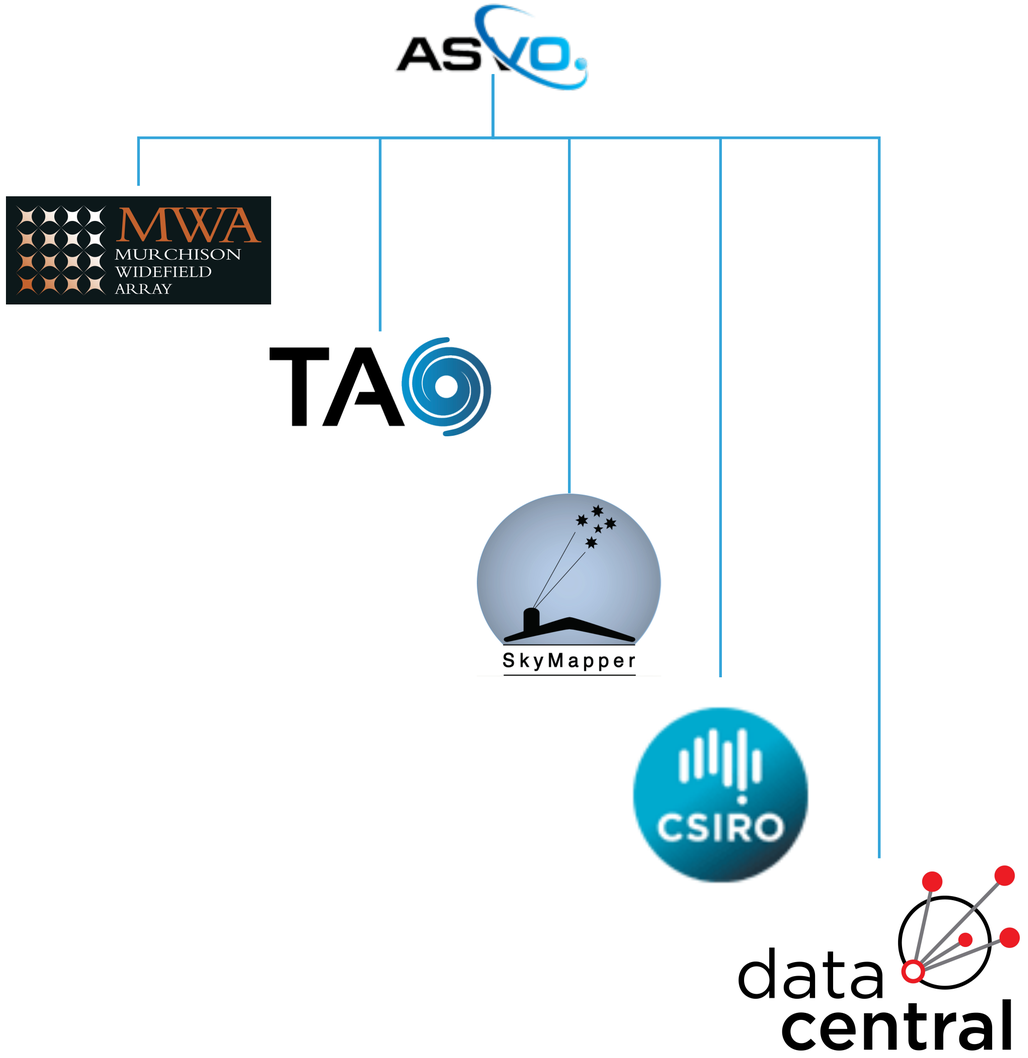
Who is building the Virtual Observatory?

The All-Sky Virtual Observatory

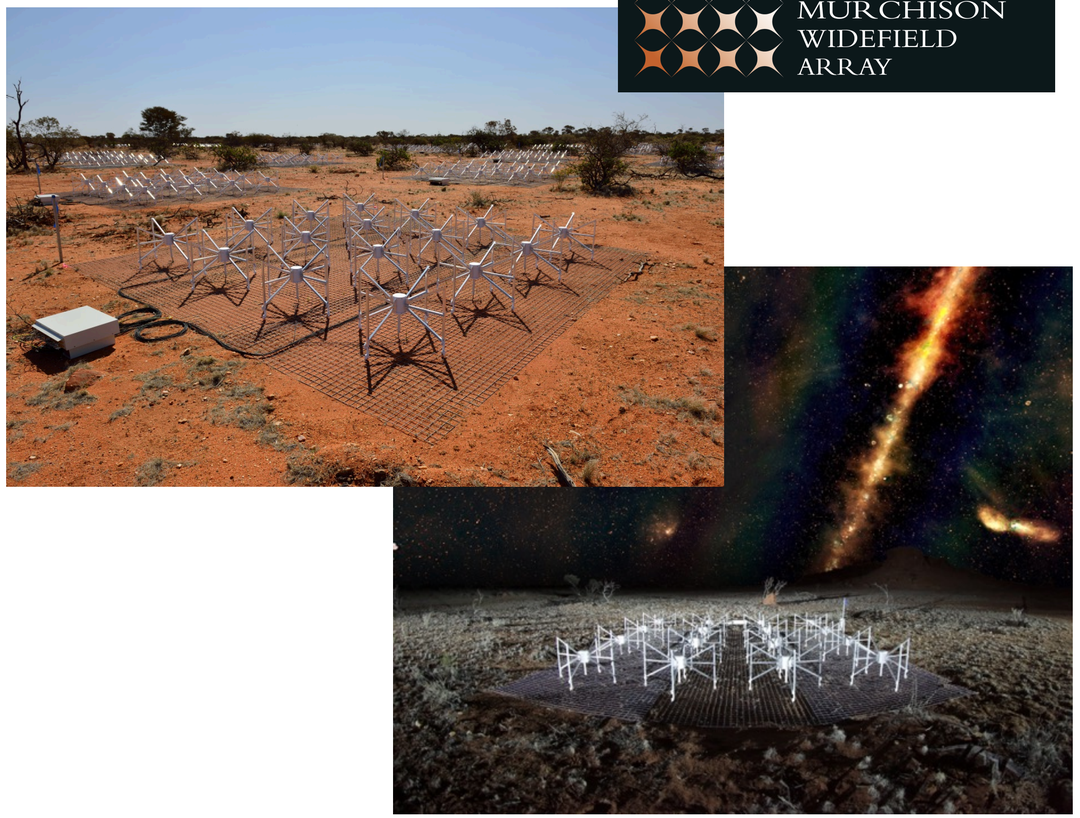
- The ASVO is the Australian member of the IVOA
- It is supported by AAL, who select a representative to sit on its Executive
- The ASVO has five nodes that coordinate much of Australia's data management and services

The All-Sky Virtual Observatory

- Murchison Widefield Array
- Theoretical Astrophysical Observatory
- SkyMapper
- CASDA (incl ASKAP archive)
- Data Central (incl AAT archive)



MWA Node

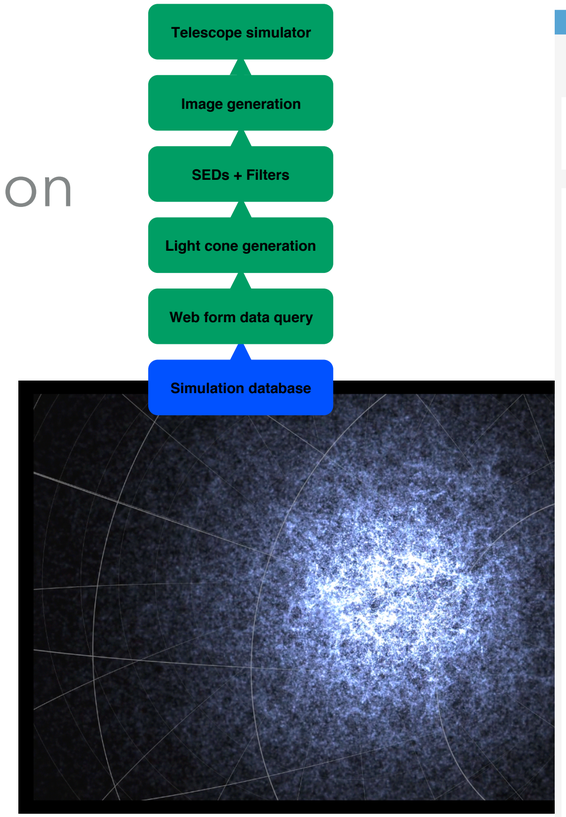


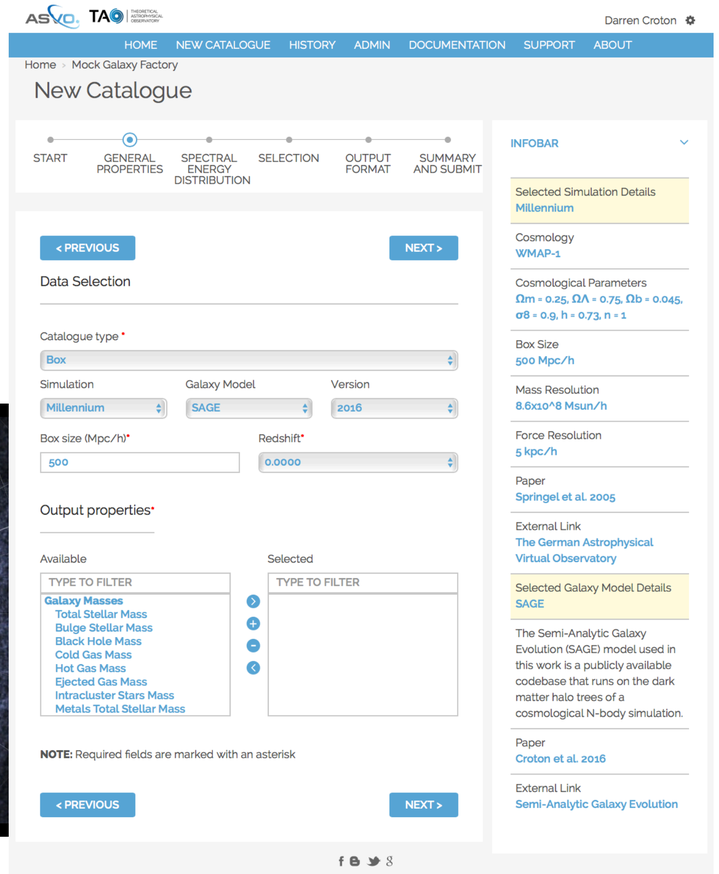
- Summary:
  - **International Consortium led by Curtin University**
  - Low frequency radio telescope (80-300 MHz)
  - Operations began mid-2013
  - Provides pre-processed uncalibrated data
  - One of the 4 SKA precursor telescopes
  - 28Pb publicly available data
  - Each observation 10-100 Gb's in size
  - MWA ASVO averages data into smaller volumes
  - MWA ASVO reduce barriers for astronomer not directly involved in the project by making manageable data

TAO Node

TAO | THEORETICAL ASTROPHYSICAL OBSERVATORY

- Summary:
  - **Led by Swinburne University**
  - Cosmological and galaxy formation simulations for astronomers
  - Launched March 2014
  - Over 1000 virtual universes built



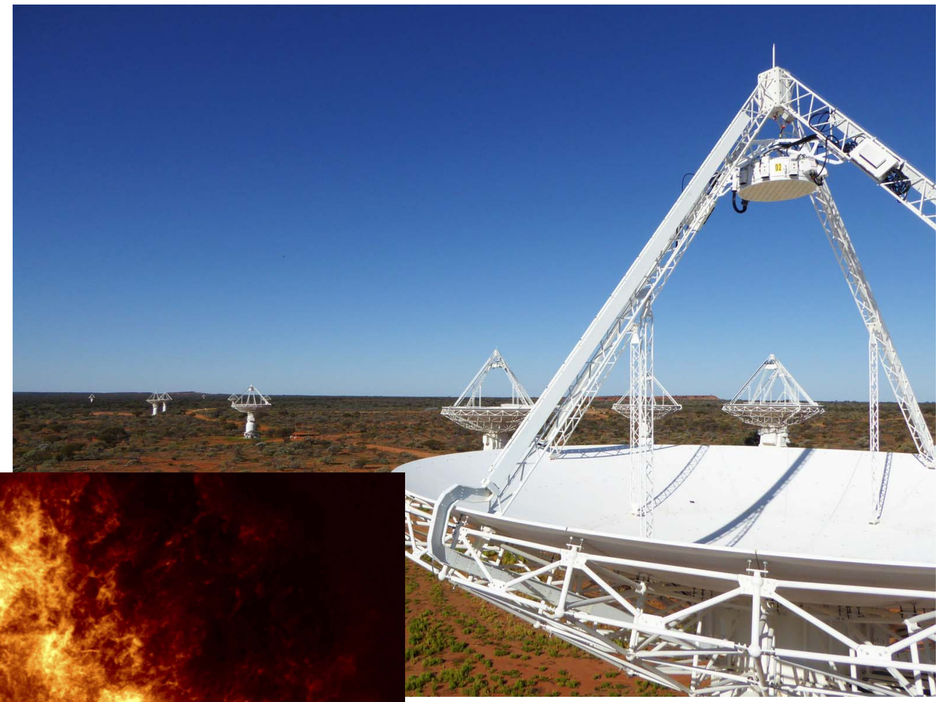


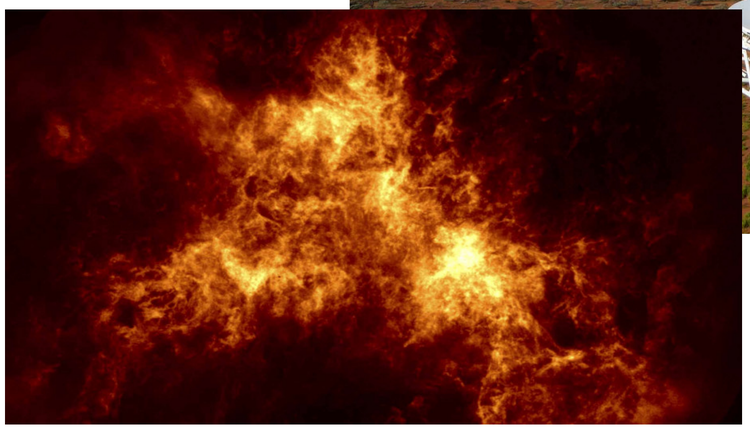
SkyMapper Node

- Summary:
  - **Consortium led by Australian National University**
  - Specially built 1.3m telescope at SSO
  - SkyMapper Southern Sky Survey
  - Digital record of the entire southern sky
  - Multi-epoch, multi-colour processed and calibrated data made available
  - Total survey >1 Pb data
  - 100 Mb data per second
  - First data release 2016

CASDA Node

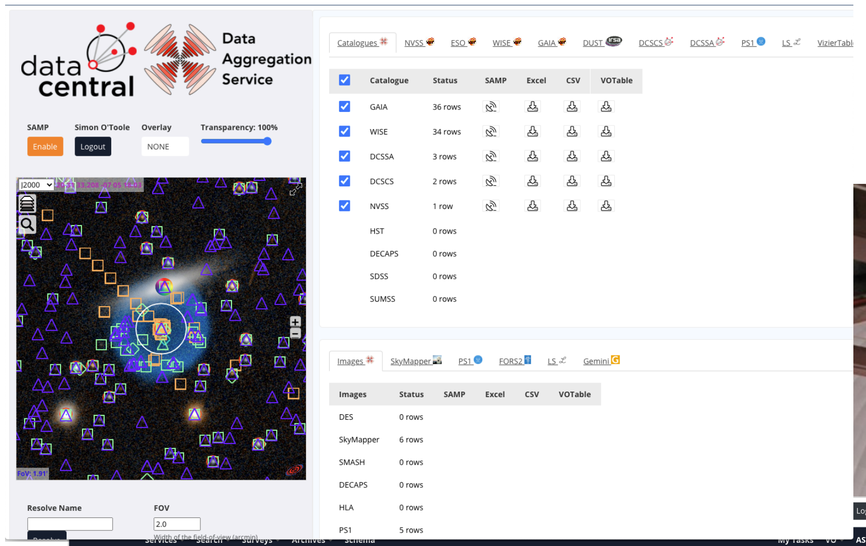
- Summary:
  - **Collaboration - CASS, CSIRO IM & T, Pawsey**
  - CSIRO ASKAP Science Data Archive
  - Data archive Australia SKA Pathfinder
  - Science ready data products
  - 5 Pb data per year (full operational mode)
  - First data release late 2015
  - 36 antenna radio telescope

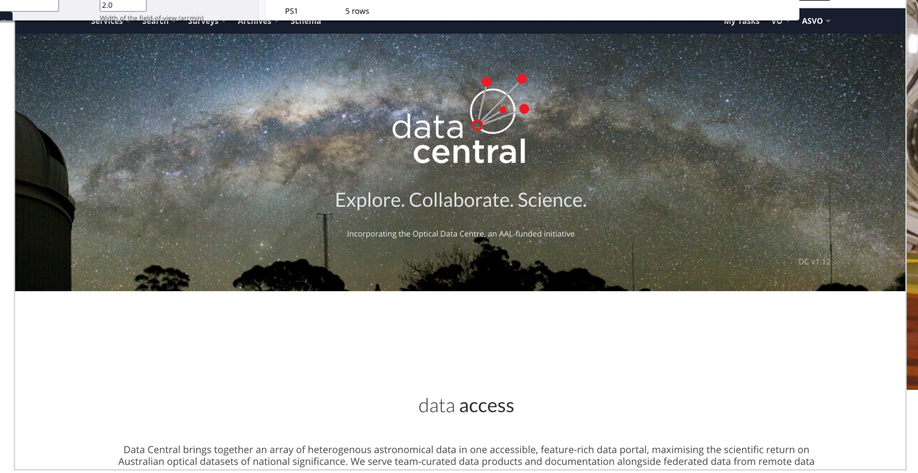


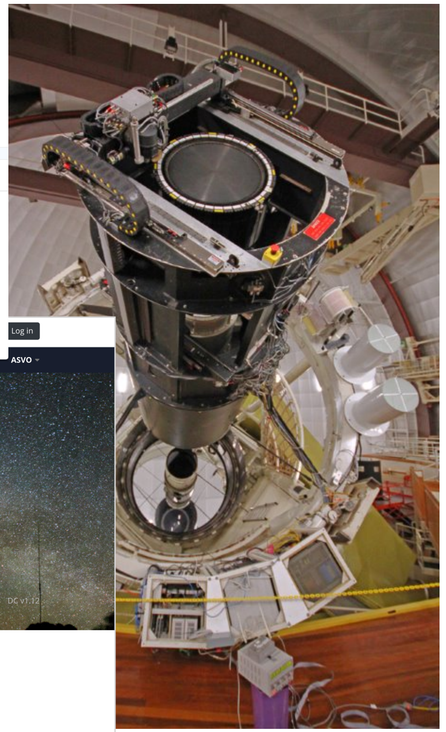


Data Central Node

- Summary:
  - **AAO Macquarie**
  - Several Virtual Observatory protocols
  - Launched 2017
  - AAT legacy data archive, 40 years
  - Heterogeneous survey data (optical and other wavelengths)
  - UI and API access







What services are there?

- *Table Access Protocol + ADQL*: query catalogue data in an archive
- *Simple Cone Search*: find your favourite objects
- *Simple Image Access*: query multiwavelength images
- *Simple Spectrum Access*: query spectra

Questions?