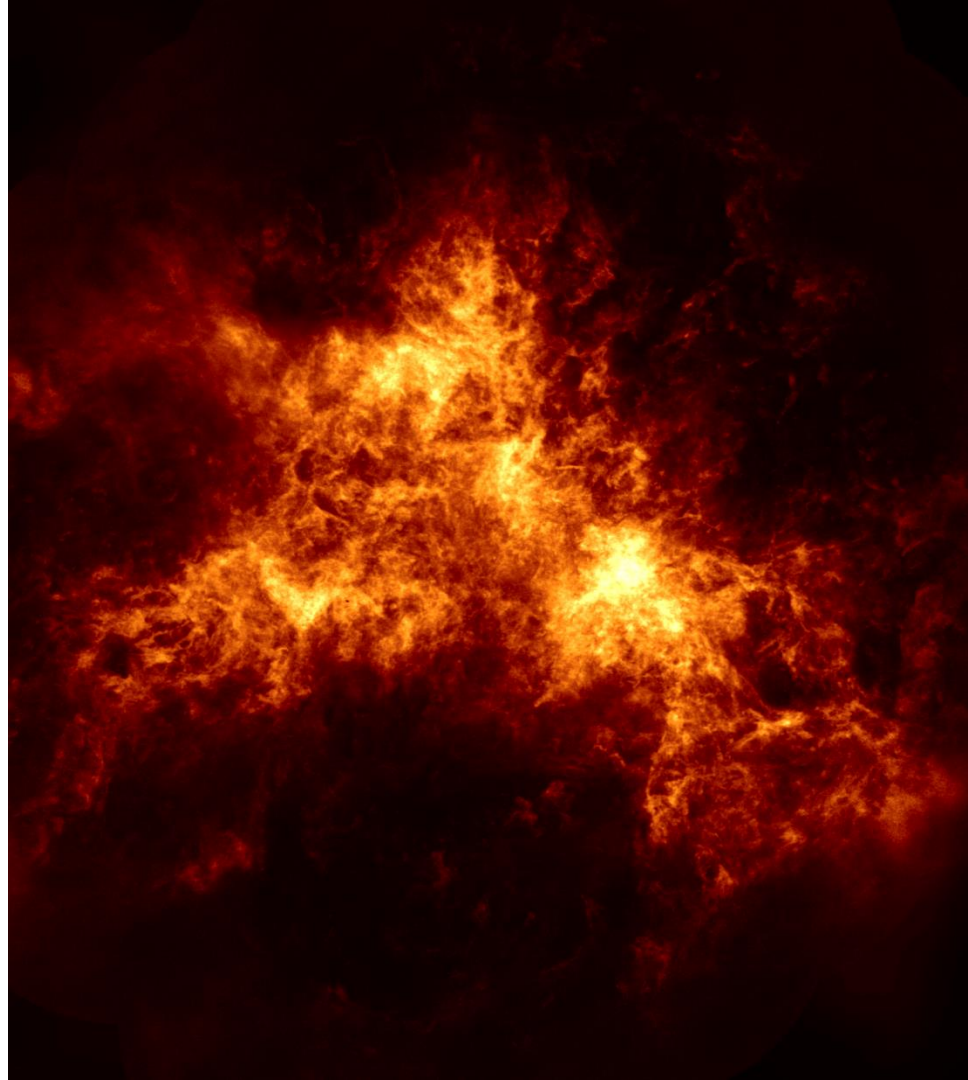# VO Powering the CSIRO ASKAP Science Data Archive

James Dempsey | 5 May 2020

Credit: ANU & CSIRO

CSIRO ASKAP Science Data Archive

- Archive for Australian Square Kilometre Array Pathfinder (ASKAP)
- Science-ready data products
- Data formats:
  - Images & Image cubes (FITS)
  - Spectra (FITS)
  - Catalogues (VOTable)
  - Visibilities (CASA Measurement Sets)

Credit: CSIRO

Other ASVO Radio Archives

- ## MWA - Murchison Widefield Array
  - Low frequency array, SKA precursor
  - Raw and calibrated visibility format
- ## PSRDA – Parkes Pulsar Data Archive
  - Parkes 64-m 'The Dish'
  - Pulsar data in time series format (PSRFITS)
- ## ATOA – Australia Telescope Online Archive
  - Australia Telescope Compact Array
  - Spectral line and continuum raw visibility data

Credit: MWA Collaboration & Curtin University

VO Protocols in the ASVO Radio Archives

Protocol	ASKAP	MWA	ATOA	PSRDA
TAP – Table Access Protocol	✓	✓	✓	✓
ObsCore	✓	✓	✓	✓
ConeSearch	✓	✓	✓	✓
Datalink	✓			
SIA2 – Simple Image Access	✓			
SSA – Simple Spectral Access	✓			
SODA- Server-side Operations for Data Access	✓			
HiPS	✓			

CASDA Aims

Data Discovery

Find data useful to you

Minimal radio astronomy knowledge assumed

Query data products

Query source catalogues

Data Access

Download entire data products

Extract small parts of very large cubes (~800GB)
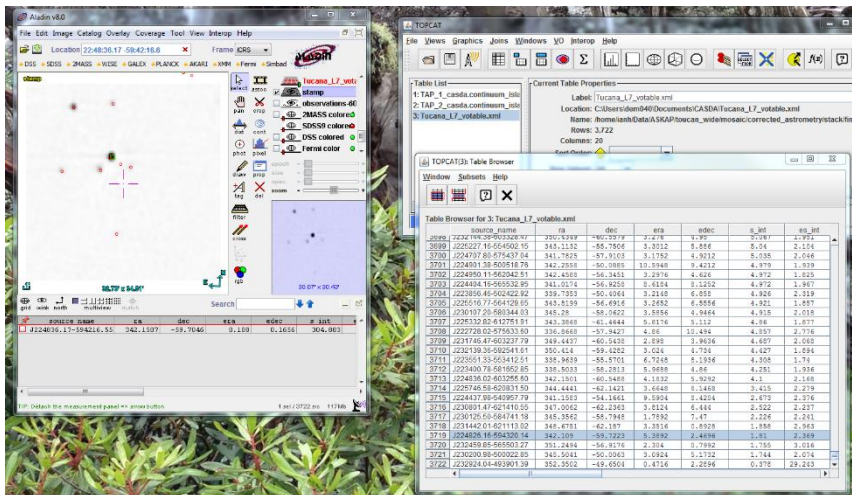
Data Publication

Science team 'value-added' data

Legacy surveys

DOIs assigned

VO Applications

- Access data directly in
  - TOPCAT
  - Aladin
  - SPLAT-VO

ASKAP Data on DAP

- ASKAP data is served through CSIRO's Data Access Portal
- These web tools also interact with the VO services
  - Downloads
  - Cutouts
  - Spectra generation
  - Catalogue queries

CASDA Astroquery Module

- Python module

- Discover and download data

- Uses:
  - SIA2, DataLink, SODA

- https://astroquery.readthedocs.io/en/latest/casda/casda.html

Download a fits image using astroquery.casda

This example script will download a continuum image of the NGC 7232 galaxy group produced from ASKAP scheduling block 2338, part of the WALLABY test observations. It demonstrates the use and features of the CASDA astroquery library.

```
In [ ]:    from astropy import coordinates, units as u, wcs
           from astropy.utils.data import download_files_in_parallel
           from astroquery.casda import Casda
           import getpass
```

First we want to look up the sky location we are interested in. We use the inbuilt SkyCoord lookup to query the CDS name resolver for the sky position.

```
In [ ]:    centre = coordinates.SkyCoord.from_name('NGC 7232')
           centre
```

Next we want to create an instance of the CASDA Astroquery object with our credentials. CASDA requires authentication to access any image products. CASDA uses OPAL credentials. Anyone can register for OPAL at https://opal.atnf.csiro.au/ The credentials will not be immediately checked, only held until they are needed.

```
In [ ]:    username = 'james.dempsey@csiro.au'
           password = getpass.getpass(str("Enter your OPAL password: "))
           casda = Casda(username, password)
```

Now we will search for CASDA data products in our area of interest, around NGC 7232. As this uses CASDA's Simple Image Access Protocol (SIAP2) service, it will return all image, cube and spectral data products, but not measurement sets or catalogues.

Note that we do not need to be authenticated to query metadata, so we just use the class rather than the instance with our credentials, although that would also work.

```
In [ ]:    result = Casda.query_region(centre, radius=30*u.arcmin, cache=False)
           result
```

The result is a table with all data products listed. However some of these data products may only be available to the project team as they have not been released yet, so we want to filter those out.

Radio Focussed Work

- SODA
  - Add CHANNEL to allow z axis to be specified in pixels
  - Have been asked to do similar for x, y axes
- ObsCore
  - Xel columns in ObsCore 1.1 very useful
    - s_xel1, s_xel2, t_xel, em_xel, pol_xel
  - May provide redundant frequency, velocity terms
  - One approach to visibilities discussed in Groningen

Thank you

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