MWA Archive & VO Overview

May 2024 IVOA Interop, Sydney (Australia)

-Mouriyan Rajendran, Curtin University/ICRAR/MWA

About the MWA

- SKA Low Precursor that is operating since 2013
- International collaboration of 26 partner institutions led by Curtin University
- Thousands of antennas
- 256 dual pol. Tiles
- MWA tile: Array of 16 dipole antennas and a beamformer (right)
- 70-300 MHz, 30.72 MHz inst. bandwidth

Cont.

- 3km or 6km max baselines

- compact configuration (blue) or extended configuration (orange) for deep surveys and detailed imaging.

- 4.7 FTE – v.small team!
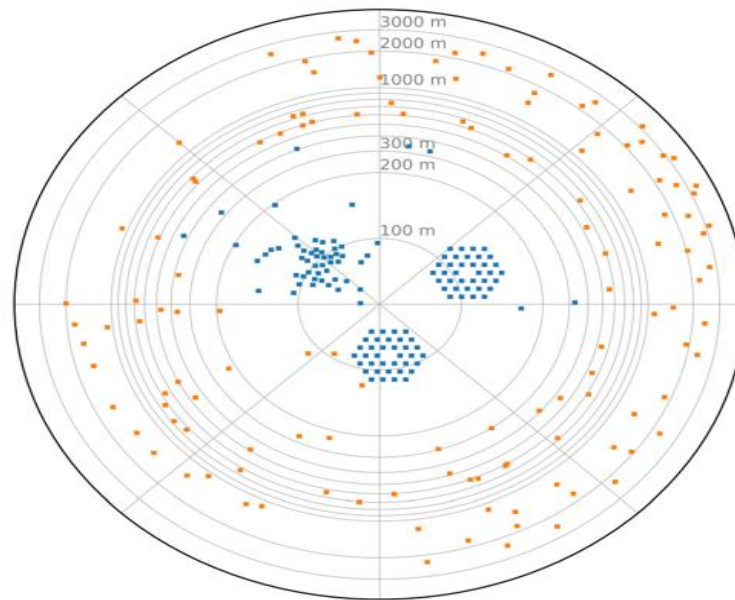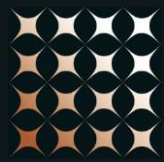
Inyarrimanha Ilgari Bundara - The Murchison Radio Astronomy Observatory (MRO)
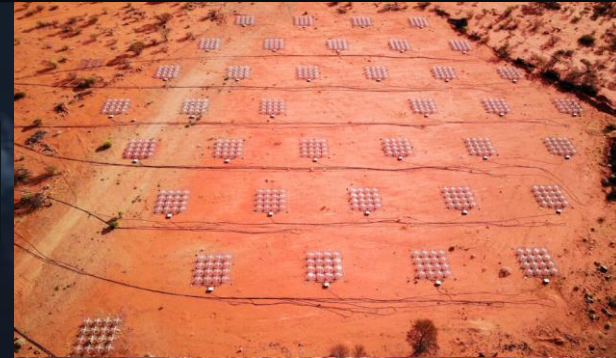
RADIO QUIET ZONE

You are now entering the Murchison Radio-Astronomy Observatory

Please switch off and do not use your mobile and satellite phones or CB radio while inside the Observatory.

Please only use these devices in case of Emergency.

Your co-operation is appreciated

MWA MURCHISON WIDEFIELD ARRAY

SKAO

MWA, ASKAP, SKA-Low, EDGES

Murchison

Sydney

Perth

Melbourne

CSIRO

MWA: Types of Raw Data

RAW Voltages
- Raw data from our receivers
- 0.781 µs time resolution (~85 TB per hour)
- Black belt MWA research groups

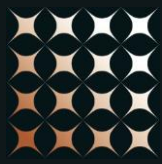**Raw uncorrected, uncalibrated visibilities**
- Bespoke MWA FITS format
- Black belt MWA research groups
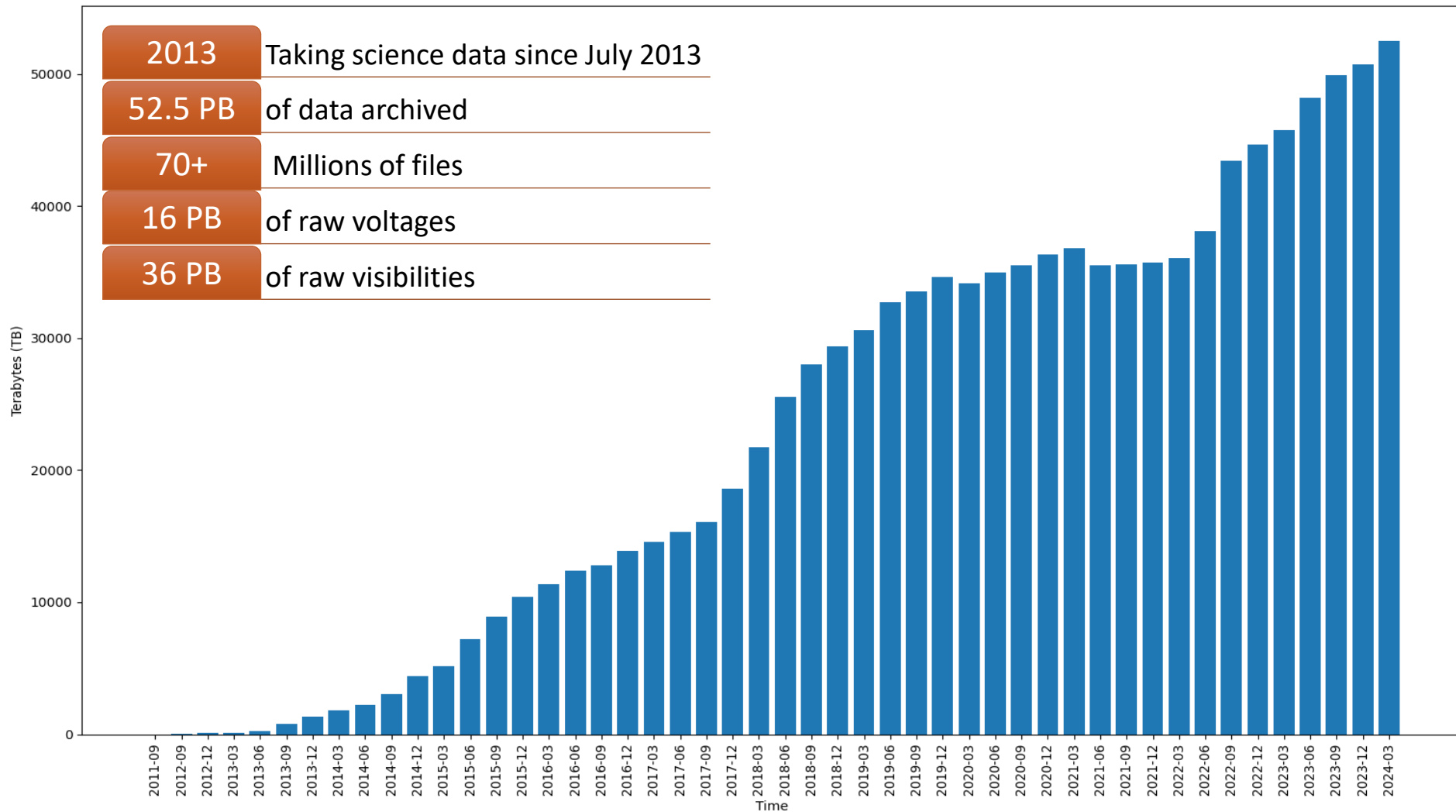
On-the-fly corrected, uncalibrated visibilities
- CASA MS or UVFITS
- Pre-processed by **Birli**
- Intermediate users do calibration themselves

On–the-fly corrected and calibrated visibilities
- CASA MS or UVFITS
- For "non-MWA radio astronomers"
- Calibration is *very* basic, but enough for simple/quick look imaging

MWA Archive Statistics

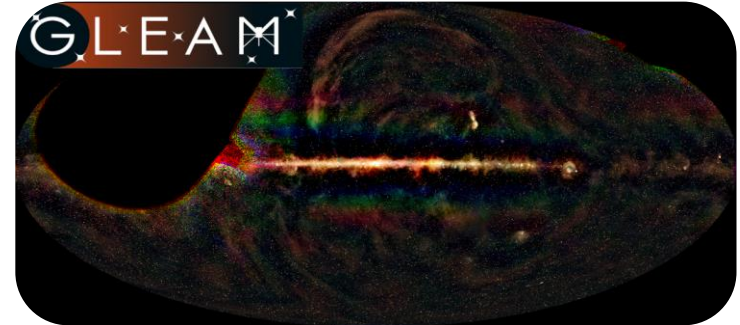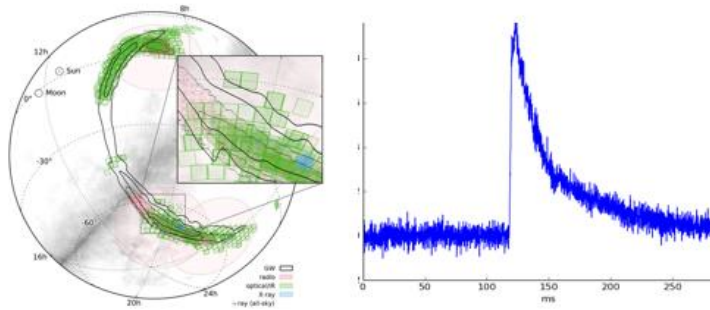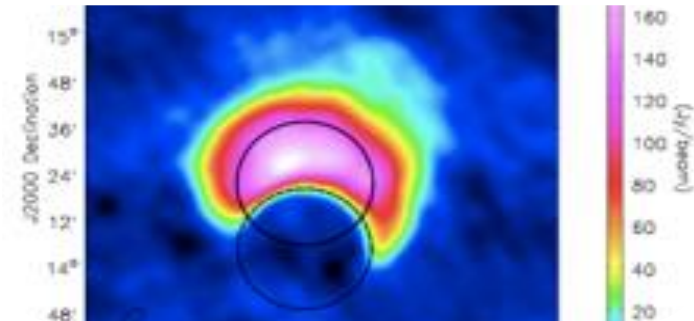|	
2013	Taking science data since July 2013
52.5 PB	of data archived
70+	Millions of files
16 PB	of raw voltages
36 PB	of raw visibilities

MWA Key Science Areas
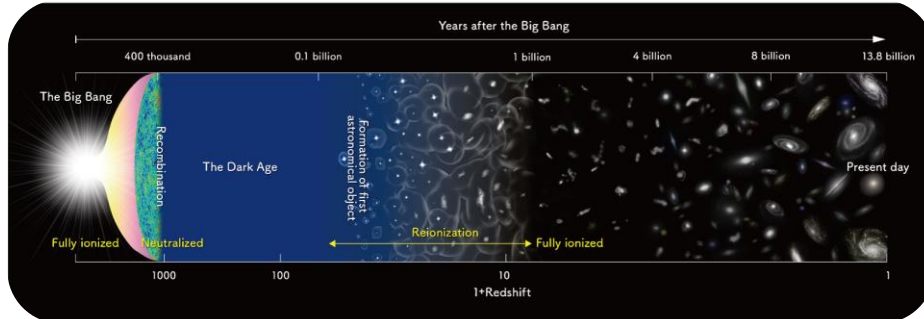
The Epoch of
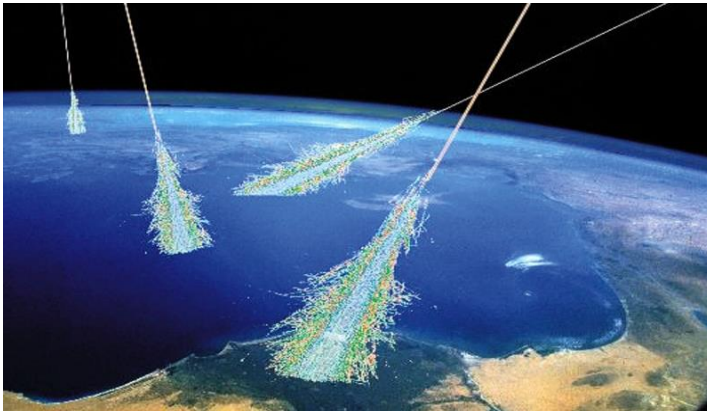Reionisation (EoR)

Galactic &
extragalactic
astrophysics

Transient & variable universe
(pulsars/FRBs/GRBs)

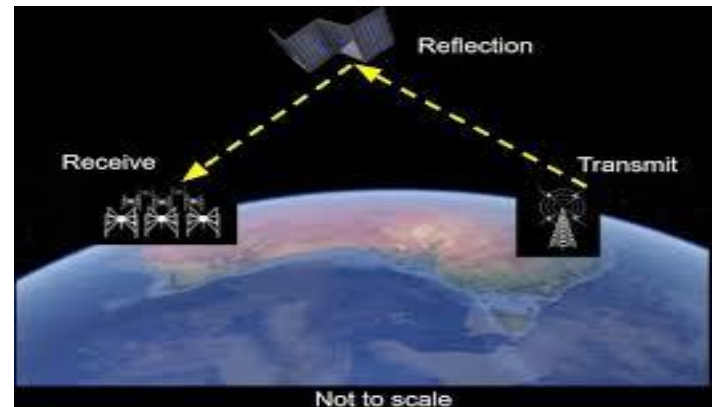Solar & heliospheric
science

MWA Science (continued)

Cosmic Rays

Search for Extra Terrestrial Intelligence (SETI)

Molecular line surveys of the Galaxy

Space situational awareness (SSA)

Images (top-left to bottom-right: space.com, ESO/M. Kornmesser,Chenoa Tremblay, Paul Hancock)
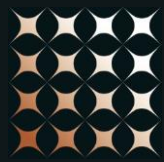
A mysterious interstellar radio signal has been blinking on and off every 22 minutes for over 30 years

Published: July 19, 2023 4.00pm EDT
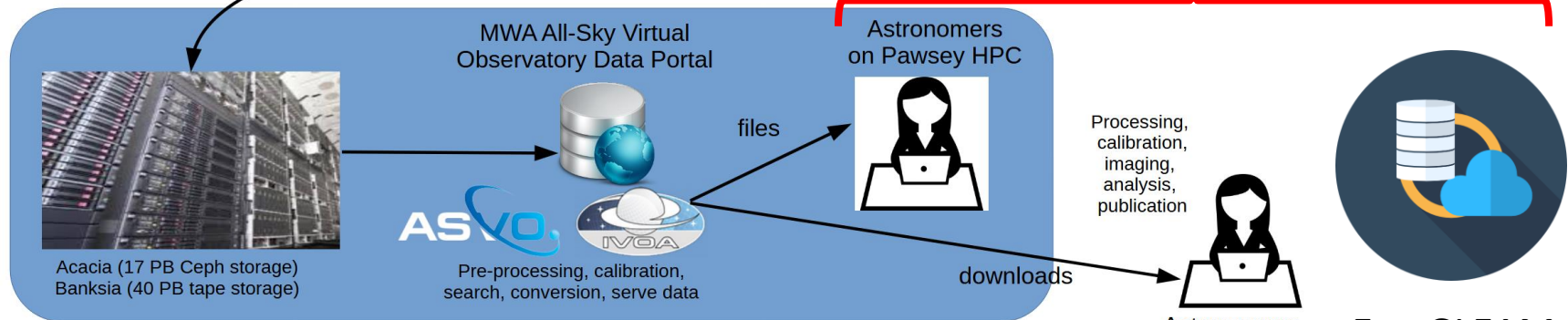
The International Centre for Radio Astronomy Research, Author provided

https://www.nature.com/articles/s41586-023-06202-5

Tier 0: Murchison Radio Astronomy Observatory (MRO), Western Australia

Curtin University

MWA tile & beamformer
256 tiles (4096 dipoles)

RFoF
Coax

Existing & new Receivers
16 Original &
2 next gen. receivers

Media conversion
10 servers

256 Gb/s

Correlator & Online Archive
24 GPU servers +
2 stand by

100 Gb/s link
up to
80 Gb/s
voltages/
visibilities

Data Cache
8 servers +
2 stand-by
~2.5 PB storage
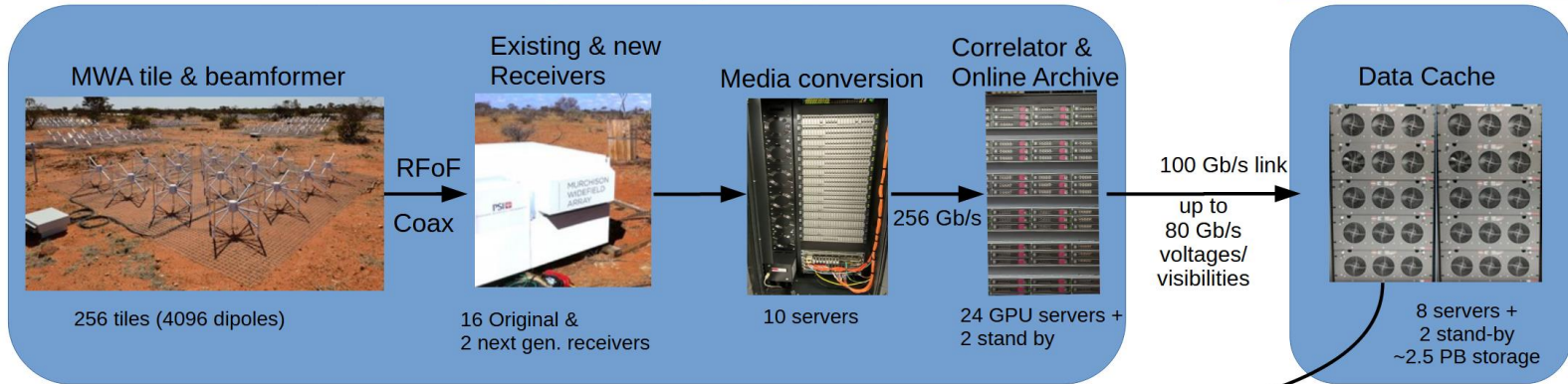
Tier 1: Curtin University,
Bentley, Western Australia

100 Gb/s link
Voltages & visibilities

Responsibility of science groups

MWA All-Sky Virtual Observatory Data Portal
Pre-processing, calibration,
search, conversion, serve data

Acacia (17 PB Ceph storage)
Banksia (40 PB tape storage)

ASVO
IVOA

files

Astronomers on Pawsey HPC

Processing,
calibration,
imaging,
analysis,
publication

downloads

Astronomers
around the world

E.g. GLEAM

PAWSEY
supercomputing centre
Tier 2: Pawsey Supercomputing Centre, Kensington, Western Australia

MWA Public Data Access

- All-Sky Virtual Observatory (ASVO) https://asvo.org.au
  - 5 data portals (including MWA)
  - https://asvo.mwatelescope.org
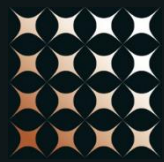
MWA Services Provided

- MWA ASVO portal (Public and proprietary)
  - Slightly federated A&A
  - Web UI
  - Command-line clients
  - **VO interfaces (TAP, SCS)**
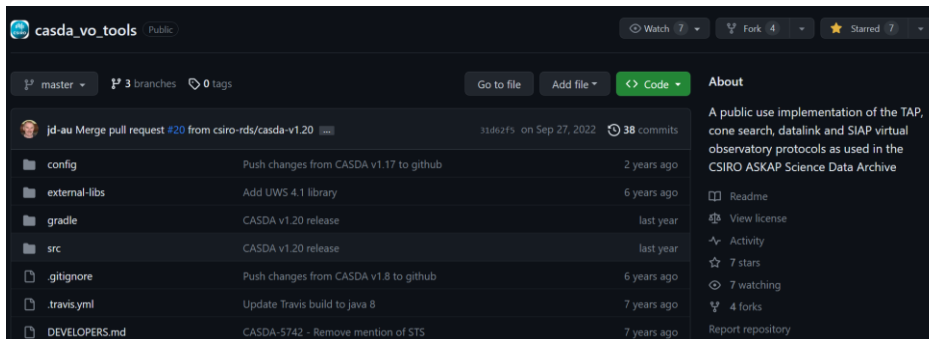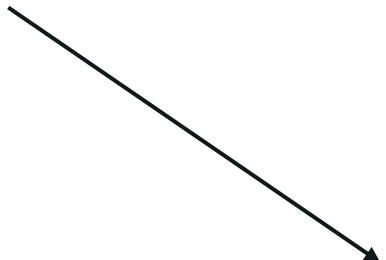
CASDA VO Tools:
Thanks, James Dempsey!

MWA Public Data Access

MWA ASVO Workflow

Register   Search   Monitor

Login   Submit jobs   Download / use Pawsey file system

MWA ASVO Workflow – CLI client

- giant-squid

- https://github.com/MWATelesco
  pe/giant-squid#readme

- Built in Rust

- mwa_client

- https://github.com/MWATelesco
  pe/manta-ray-client#readme

- Built in Python

Get a CLI client   Search and get csv of obs   Monitor

Get API Key   Submit jobs   Download / use Pawsey file system

Motivations for TAP design

- Make mwa.observation "one stop shop"
- Machine AND human readable
- Use MWA terminology
- Unification of data portal search and TAP
- Simple
  - Denormalised
  - No joins or complex ADQL required for most use cases
  - Don't make the user write code if they don't have to!

- Get TAP service in a registry (!)
- Add more metadata to TAP
- Add support for Astroquery
- MWA archive serves "raw" data- very high barrier to entry and access- try to lower the bar!
- Moving users/code close to data a challenge when it's not your compute facility!
- Data not directly accessible (staging / pre-processing required)
- How can we be FAIR-er?

Thank you

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Developer

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🌐 http://www.mwatelescope.org

🌐 https://asvo.mwatelescope.org

🐦 @mwatelescope

f Murchison Widefield Array

We acknowledge the Wajarri people as the traditional owners of the MRO site.

MWA Collaboration