LBA

(Long Baseline Array)

Update

Phil Edwards

28 March 2023

Wajarri artist Vanessa Kelly

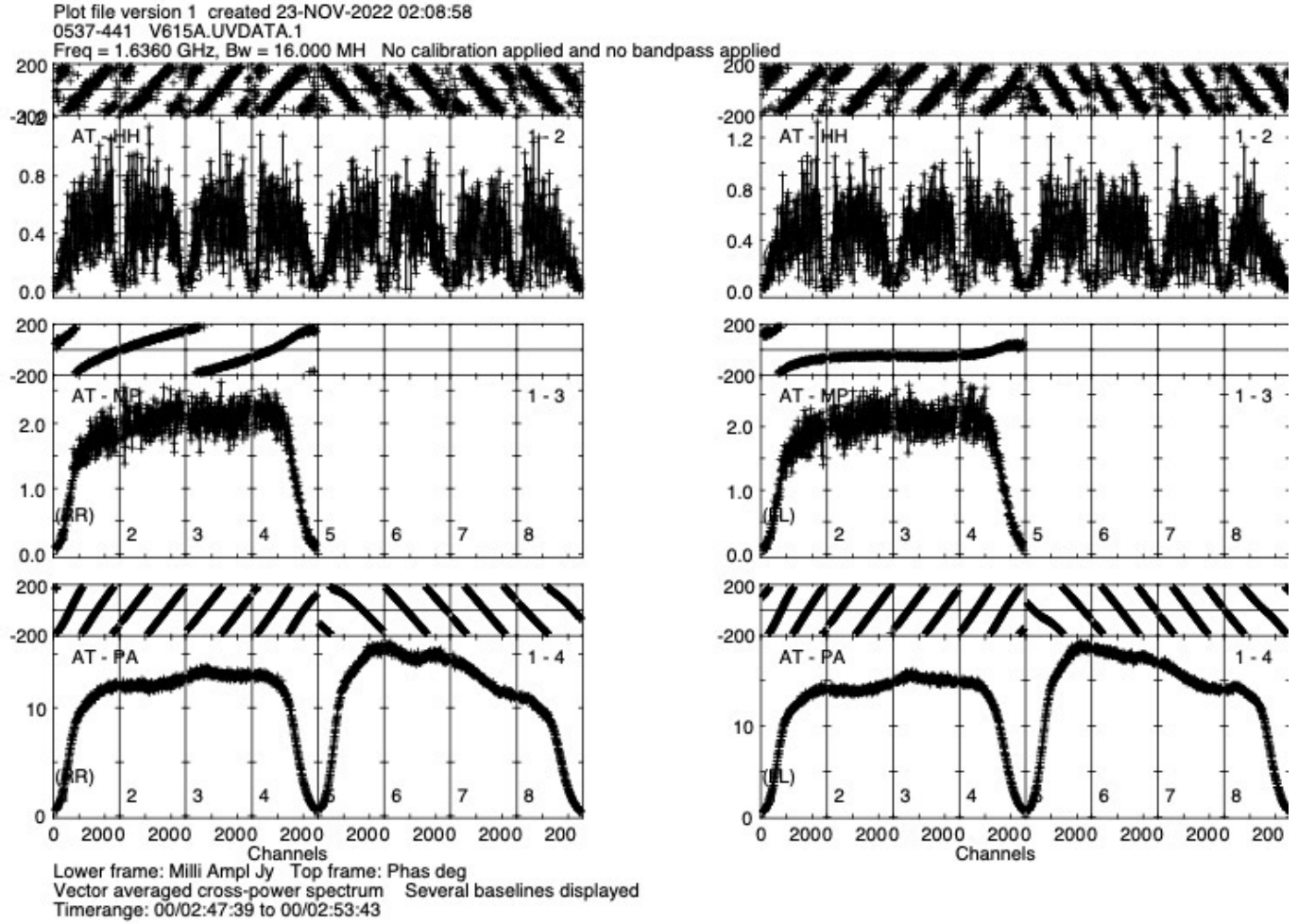
Outline

- Current status
- Science highlight
- The LBA in the BIGCAT & CryoPAF era
- Low-frequency VLBI – LAMBDA
  - Low-frequency Australian Megametre-Baseline Demonstrator Array
- LBA Science Case

Current Status

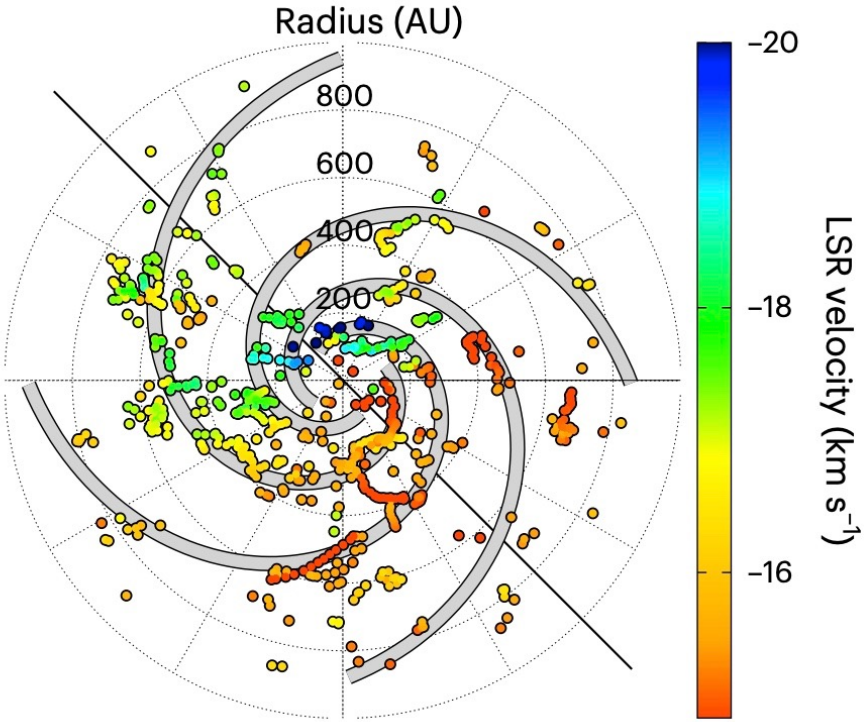
- LBA key elements are Parkes, ATCA, Mopra, Hobart, Ceduna, Katherine, Yarragadee, Warkworth, Hartebeesthoek, Tidbinbilla
- 4~5 blocks of 4~6 days each year, plus out-of-session observations
- Typically ~10 proposals per semester
- Warkworth (12m and 30m) being transferred from AUT
- Hobart 26m operational again following bearing failure in 2021
- ATCA and Mopra participation in Global mm VLBI Array 3mm obs
- Mopra under contract with KASI for KVN+ VLBI observing
- Increasing collaboration with the East Asia VLBI Network
- LBA data correlated at Pawsey using DiFX, now on setonix

First Fringes on Setonix



Science highlight

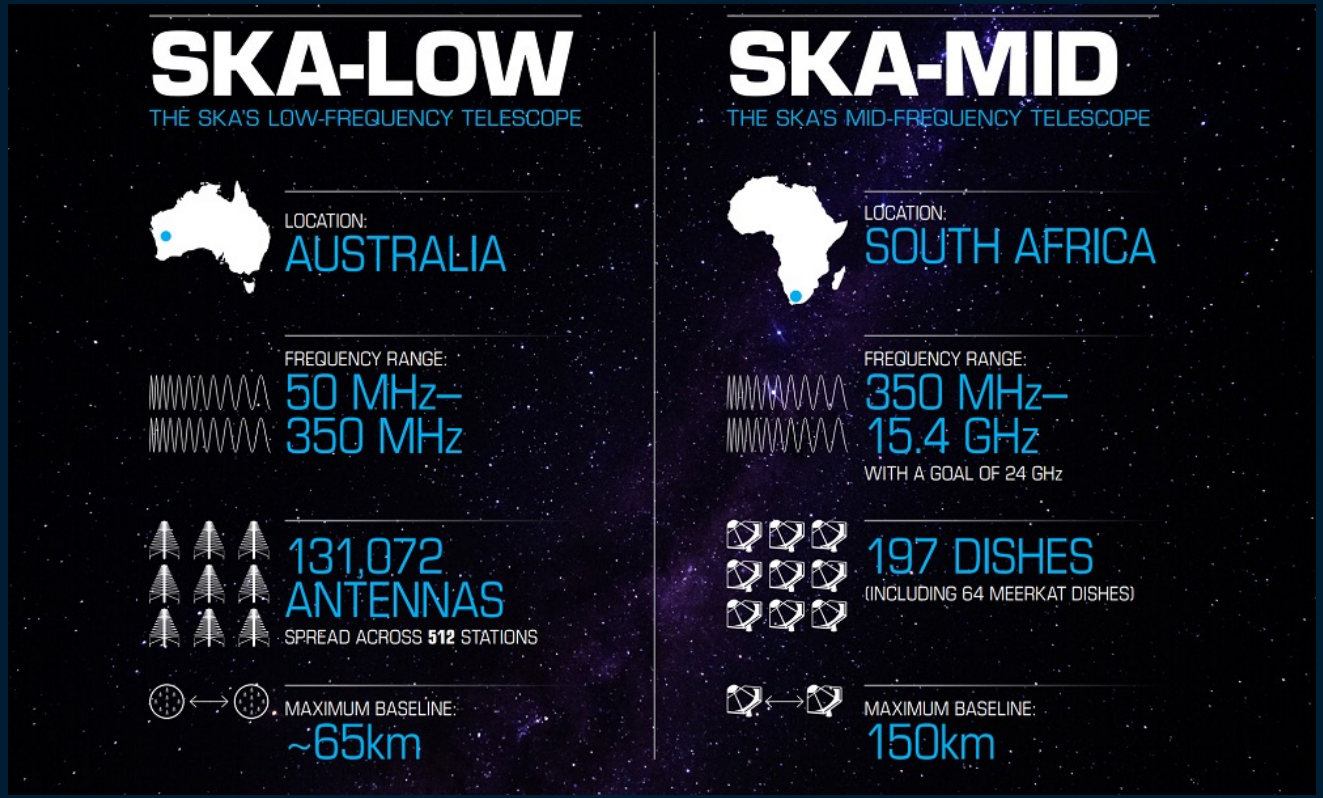
- The LBA and other VLBI arrays have traced a burst of radiation propagating outward from the high-mass protostar G358.93-0.03-MM1
- The figure shows the methanol maser spotmaps of the combined six-epoch data sets centred on the G358-MM1 position
- This result positively implicates disk accretion and spiral arm instabilities into the episodic accretion high-mass star formation paradigm



Burns et al. 2023 Nature Astronomy

LBA in the BIGCAT/CryoPAF era

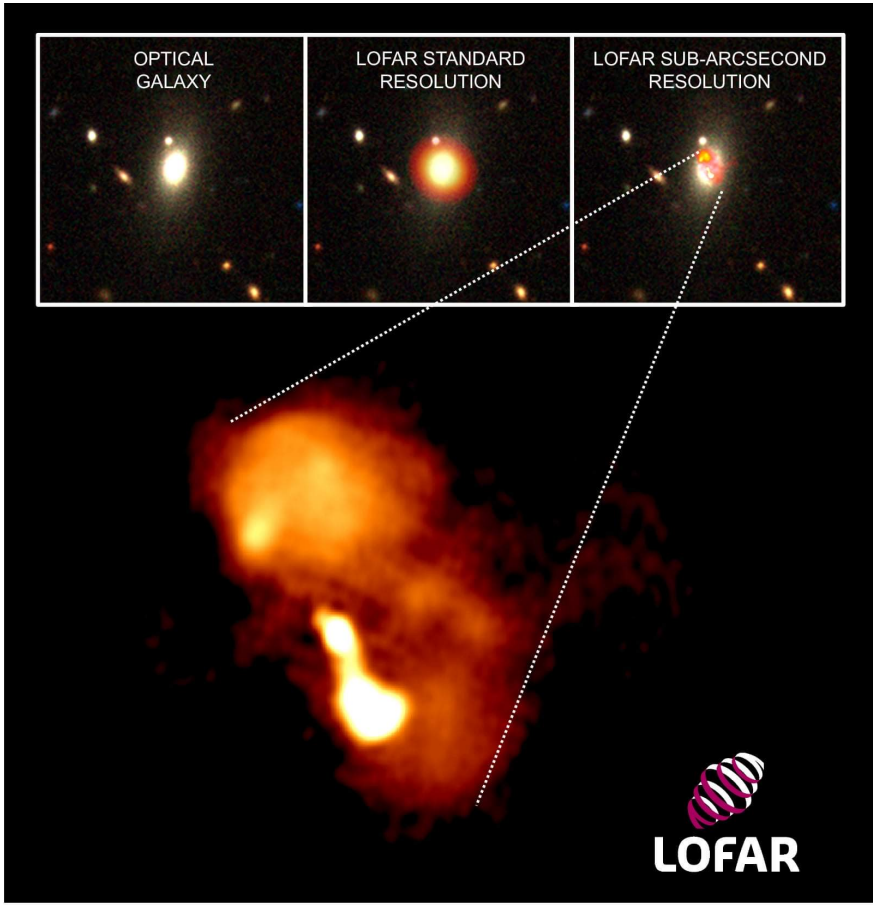
- Major upgrades at ATCA and Parkes in mid-2023
- LBA session in April/May, next session pencilled in for September
- BIGCAT removes one hurdle for increasing recording rate beyond 1 Gbps
- CryoPAF and BIGCAT will provide multiple beams
- CryoPAF and UWL use all the real estate in Parkes focus cabin
  - UWH can be accommodated in UWL package, but LIEF grant unsuccessful
  - Consideration to removing one or other 1~2 times a year for VLBI > 4 GHz



The SKA telescopes are very sensitive, but their highest angular resolution images will come through co-observing with other telescopes – VLBI

Low frequency VLBI

- Turbulence in the Earth's ionosphere has traditionally made VLBI challenging at frequencies below ~500 MHz
- The International LOFAR Telescope has demonstrated that this problem is now tractable on baselines up to ~2000km



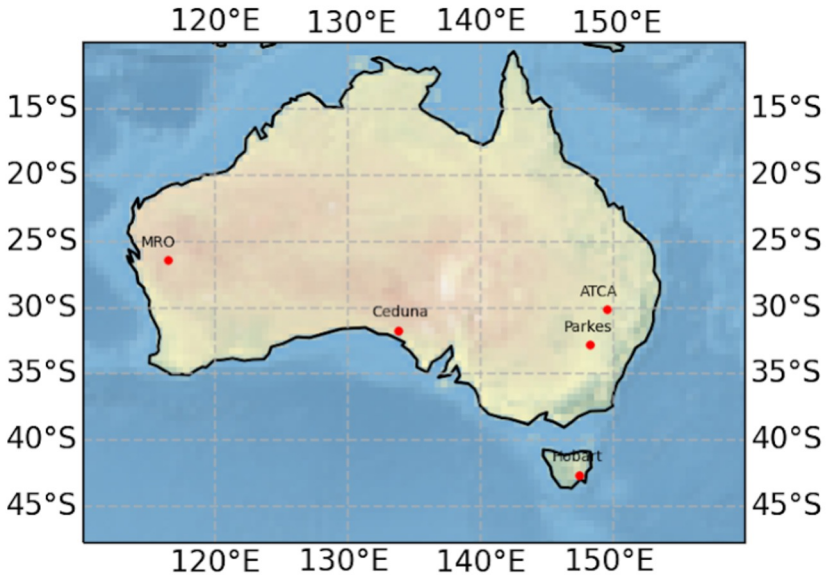
Galaxy-scale jets revealed by new calibration techniques
("Sub-arcsecond imaging with the International LOFAR Telescope"
Special issue, 2022, A&A, 658)

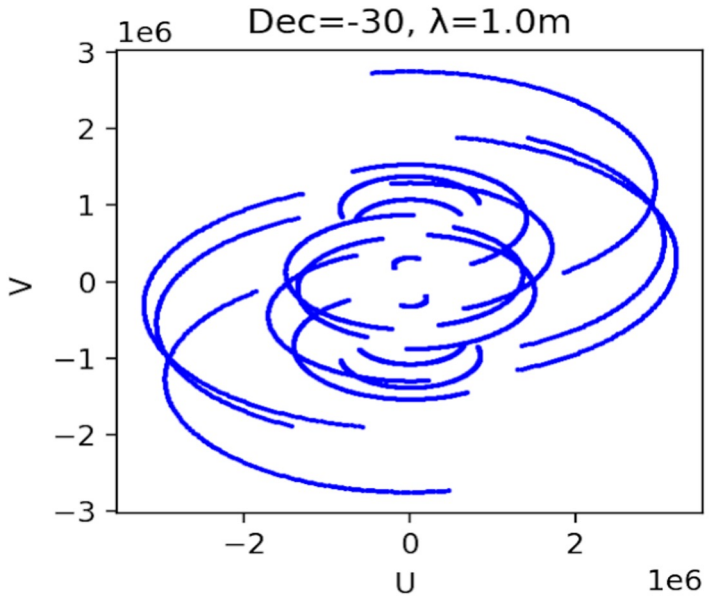
LAMBDA test-bed at Narrabri

- 16 dual-pol MWA antennas + ground-plane
- Mains power complete
- Fibre to Control Building for timing, data, control

LAMBDA project - indicative (u,v) coverage

Initial locations selected to coincide with existing LBA sites for power, network…





Plots courtesy of Cormac Reynolds (CSIRO) and Yun Yu (SHAO)

Low-frequency VLBI science cases

- High resolution (sub-kiloparsec scale at all redshifts) mapping of AGN and other radio sources detected with ASKAP, MWA, MeerKAT, and SKA-Low and SKA-Mid
  - 2/3 of ASKAP sky inaccessible at low frequencies with long baselines
- Pulsar astrometry, distances, proper motions, scintillometry
- Young stellar objects and Supernova Remnants in our Galaxy
- Gravitational lens imaging
- Resolving stellar systems, distinguishing planet from host star
  - (e.g., Sun-Jupiter system to D ~ 50 parsecs)
- FRB follow-up and host imaging with optical resolution
- Determination of high-precision ISM properties, SETI

LBA Science Case

- Future Science Cases were prepared for the ATCA and Parkes in 2020 (and are available from the ATUC webpage)
- Both included sections on future VLBI capabilities
- An LBA Science Case is currently in preparation, including consideration of stand-alone LBA, LBA in the SKA era, and low frequency VLBI

Thank you

CSIRO Space and Astronomy
www.atnf.csiro.au