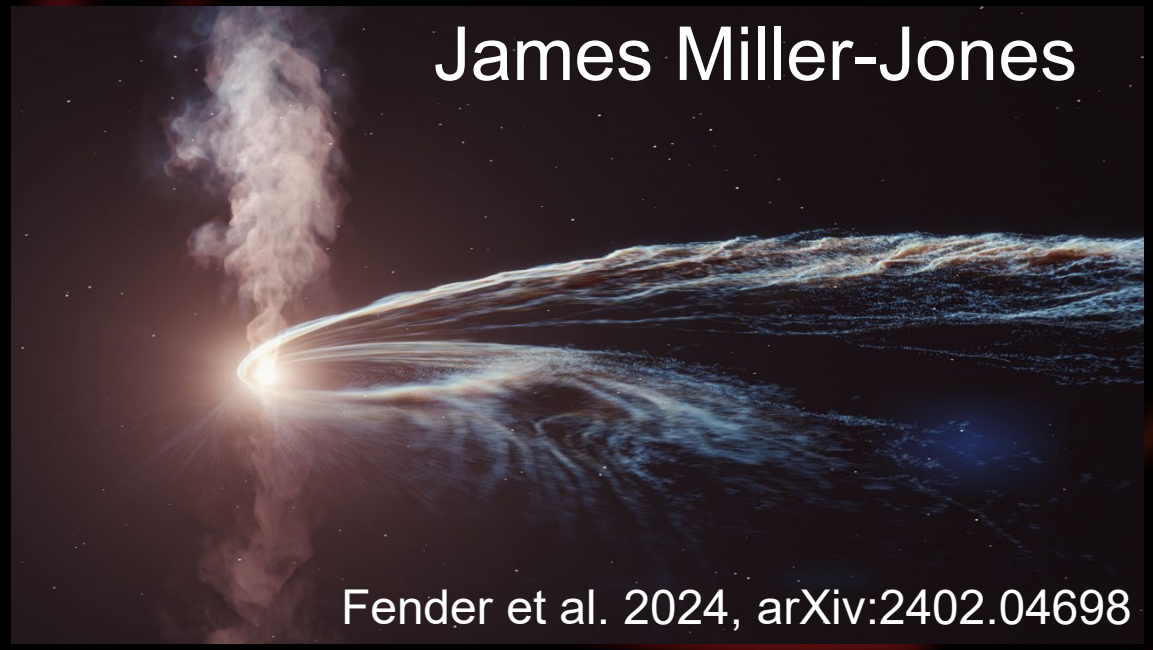
A southern-hemisphere radio transients facility?

James Miller-Jones



ICRAR
International Centre for Radio Astronomy Research

Curtin University

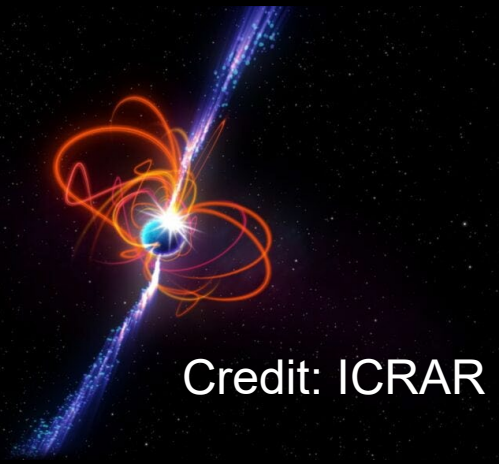
GOVERNMENT OF WESTERN AUSTRALIA

THE UNIVERSITY OF WESTERN AUSTRALIA

ICRAR is a joint venture between Curtin University and The University of Western Australia and receives support from the Western Australian and Australian Governments.

Radio transients

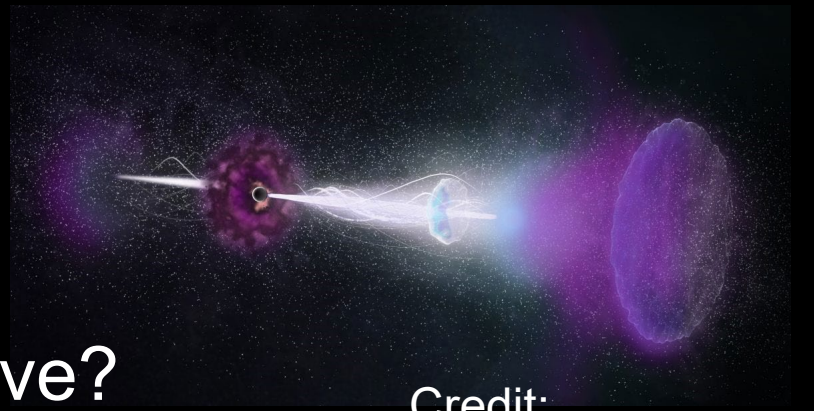
- Probing physics under the most extreme conditions
- Tracer of particle acceleration and coherent processes
- Determine the budget of kinetic energy feedback



Credit: ICRAR

Key questions:

- What populations produce energetic transients?
- What kinds of transients produce jets?
- What can we learn about particle acceleration?
- How do compact stellar remnants form and evolve?



Credit: NRAO/AUI/NSF

An explosion of transient science

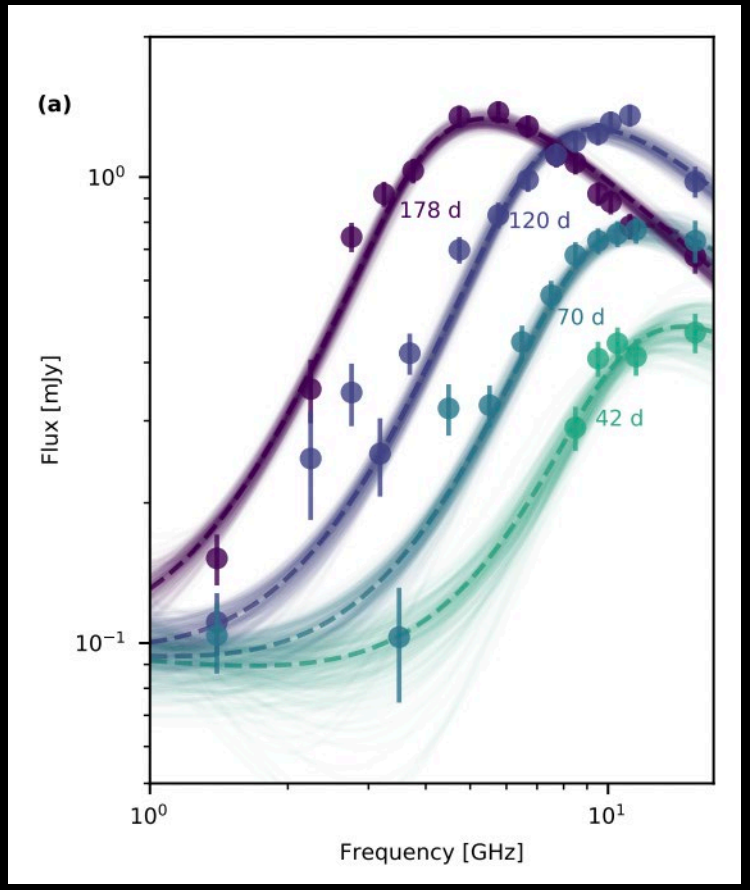
- ASKAP-VAST survey underway
- VRO/LSST coming online this year *(Moller)*
- CTA operations starting in ~2026 *(Rowell)*
- SKA operations late this decade (*An/Li*)
- *Southern hemisphere transient discovery machines!*

Key opportunity:

- Southern-hemisphere follow up
  - ATCA is uniquely positioned
    - High sensitivity interferometer
    - Broad frequency coverage
    - Full polarization

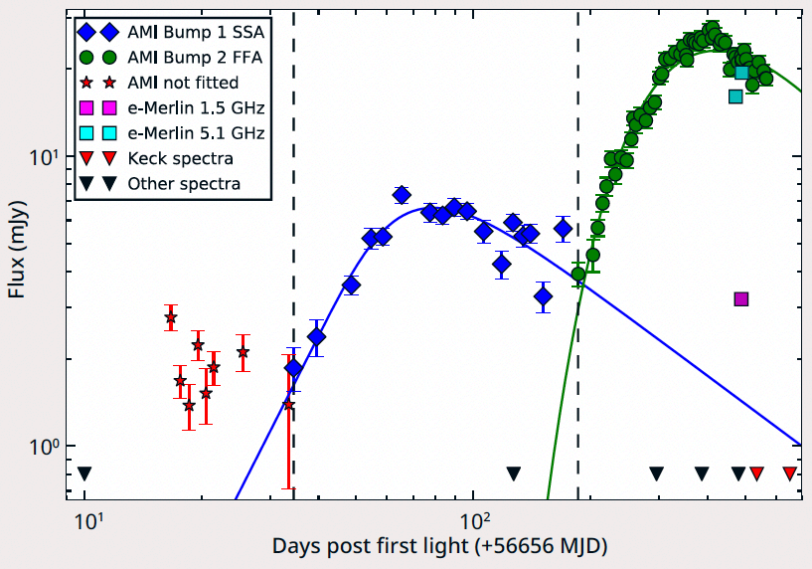
The value of a dedicated transients facility

- Time domain science requires
  - Rapid response
  - High cadence
  - Long observations
  - Long-duration late-time monitoring
- And yet:
  - Time on major facilities is extremely valuable
  - Full SKA sensitivity not required for most transients
  - Loss of antennas to subarrays not often acceptable
- Compare to optical astronomy
  - Small (robotic?) facilities co-exist with large-scale telescopes
  - *Unique niche*

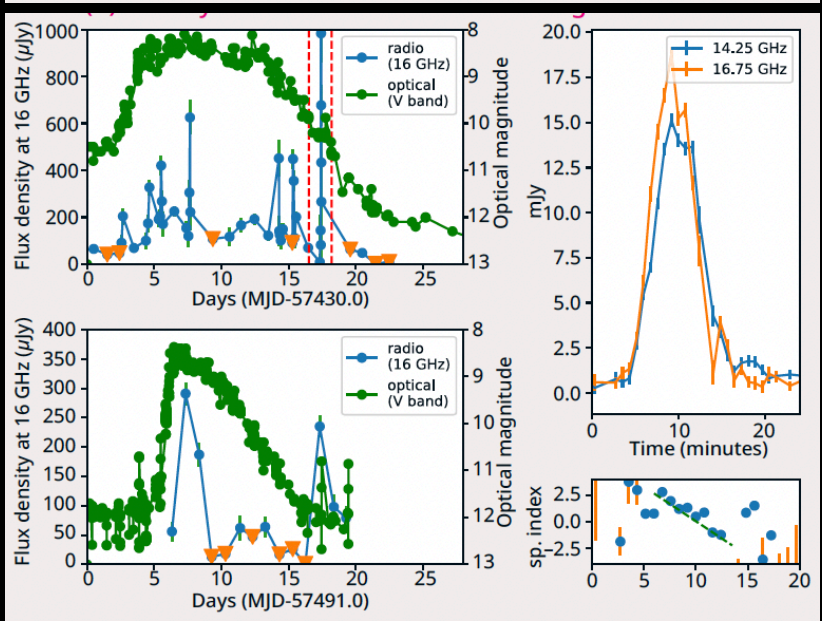


Stein et al. (2021)

Radio transients pathfinder: AMI-LA

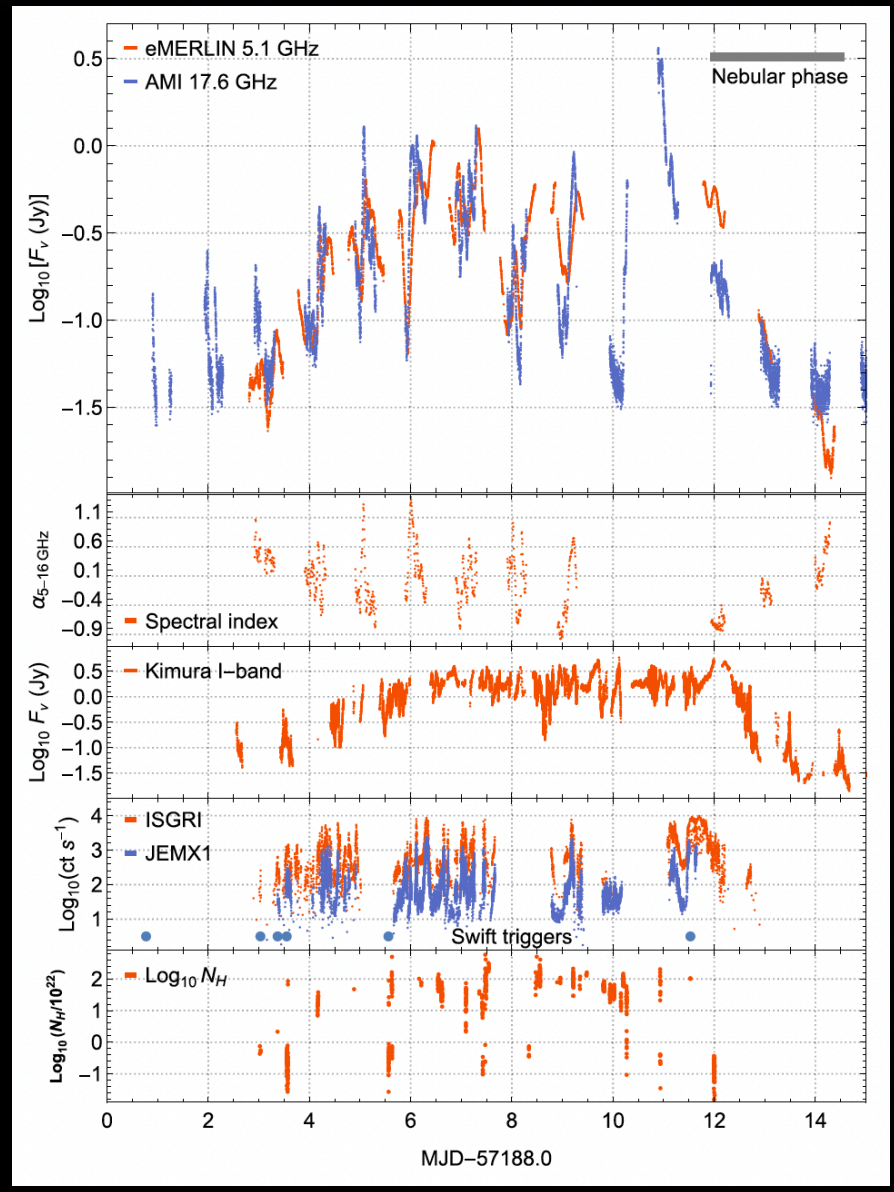


SN progenitor mass-loss history: Anderson+17



Dwarf nova radio flares: Fender+19

Super-Eddington X-ray binary: Fender+23

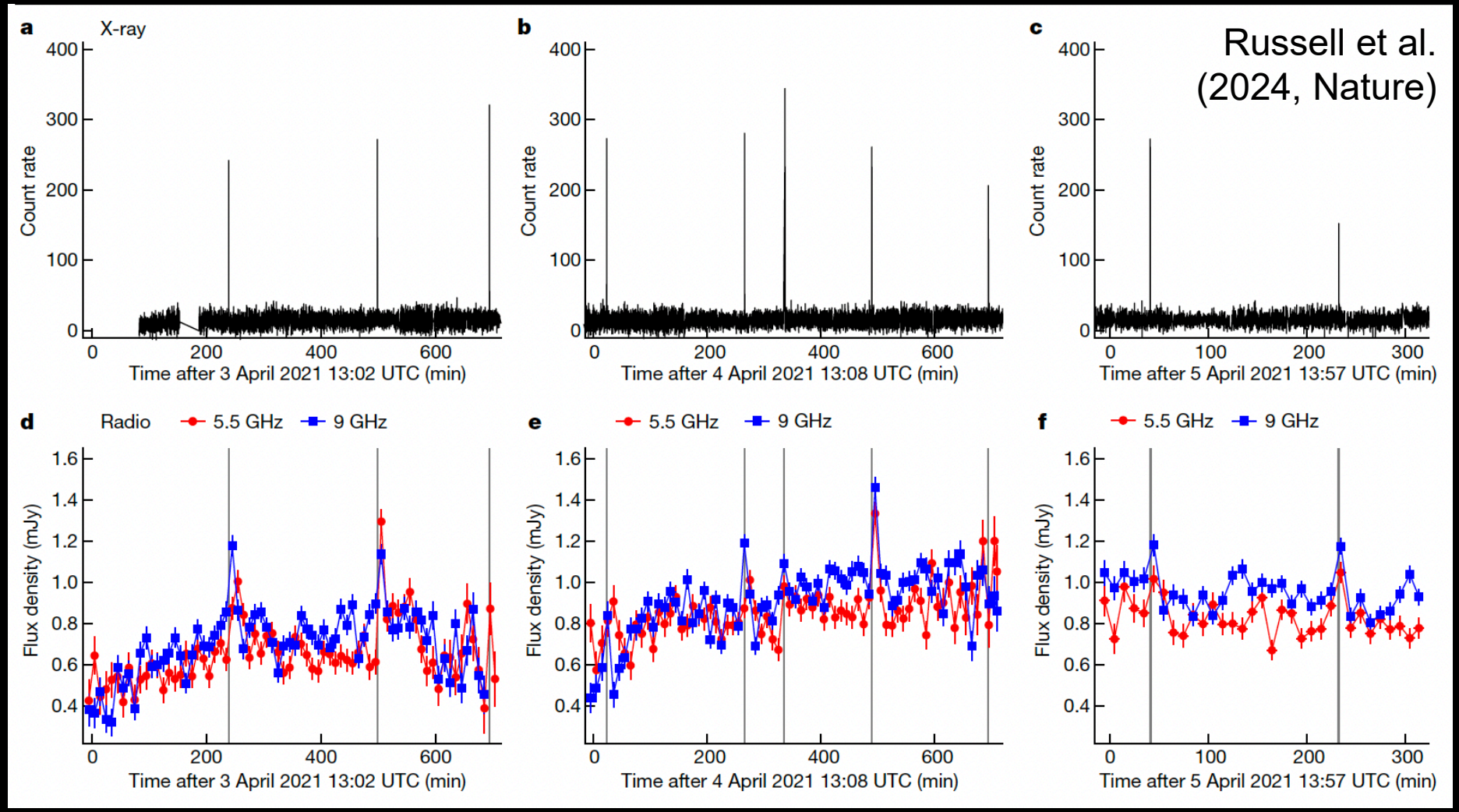


ATCA's advantages

	ATCA	AMI-LA	ATA	KAT-7
Array	6 x **22m**	8 x 13m	42 x 6.1m	7 x 12m
Configuration	E-W	2-D	2-D	2-D
Collecting area (m2)	**9123**	4247	4909	3166
Frequency range (GHz)	**1-90**	12-18	1-11	1.2-1.95
Bandwidth (GHz)	**8**	6	2 x 0.67	0.256
Polarization	**Full**	Single	Full	Full
Maximum baseline (m)	**6000**	110	323	185
Latitude	**-30**	+52	+41	-30

What role can ATCA play?

- High time resolution is possible, even with an E-W array



A potential path forward?

- ARC LIEF scheme permits:
  - Leasing of facilities
  - Subscription/co-ordinated access to major national facilities

- Australian+international transient consortium
- Dedicated southern-hemisphere transient response
- Triggering, high-cadence monitoring of most exciting events
- Lessons from AMI-LA, ATA, ThunderKAT

- Funding for a fraction of dedicated ATCA time?
  - c.f. Mopra LIEF
- Automated scheduling/observing/processing?
- BIGCAT allows more streamlined VLBI follow up? *(Gourdji)*

Fender et al. 2024, arXiv:2402.04698

Summary

- Huge upcoming opportunities in time-domain radio astronomy
- Most powerful facilities will not be able to take advantage
- Niche for agile smaller facilities ***in the south!***
- ATCA is the most capable facility in the world for this

- *Can we build from the active Australian and international transients communities to realise this opportunity?*

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