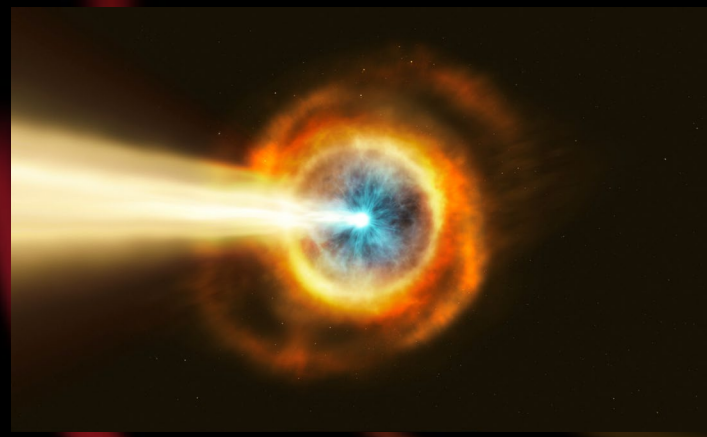
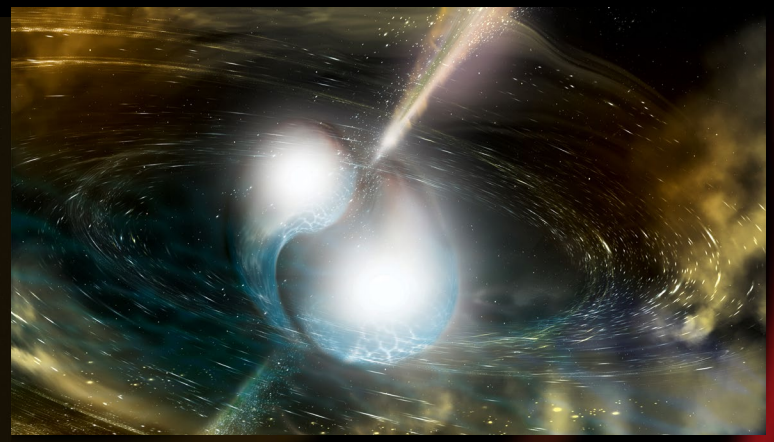
# Rapid-response triggering on transients with ATCA






Gemma Anderson

ICRAR- Curtin University

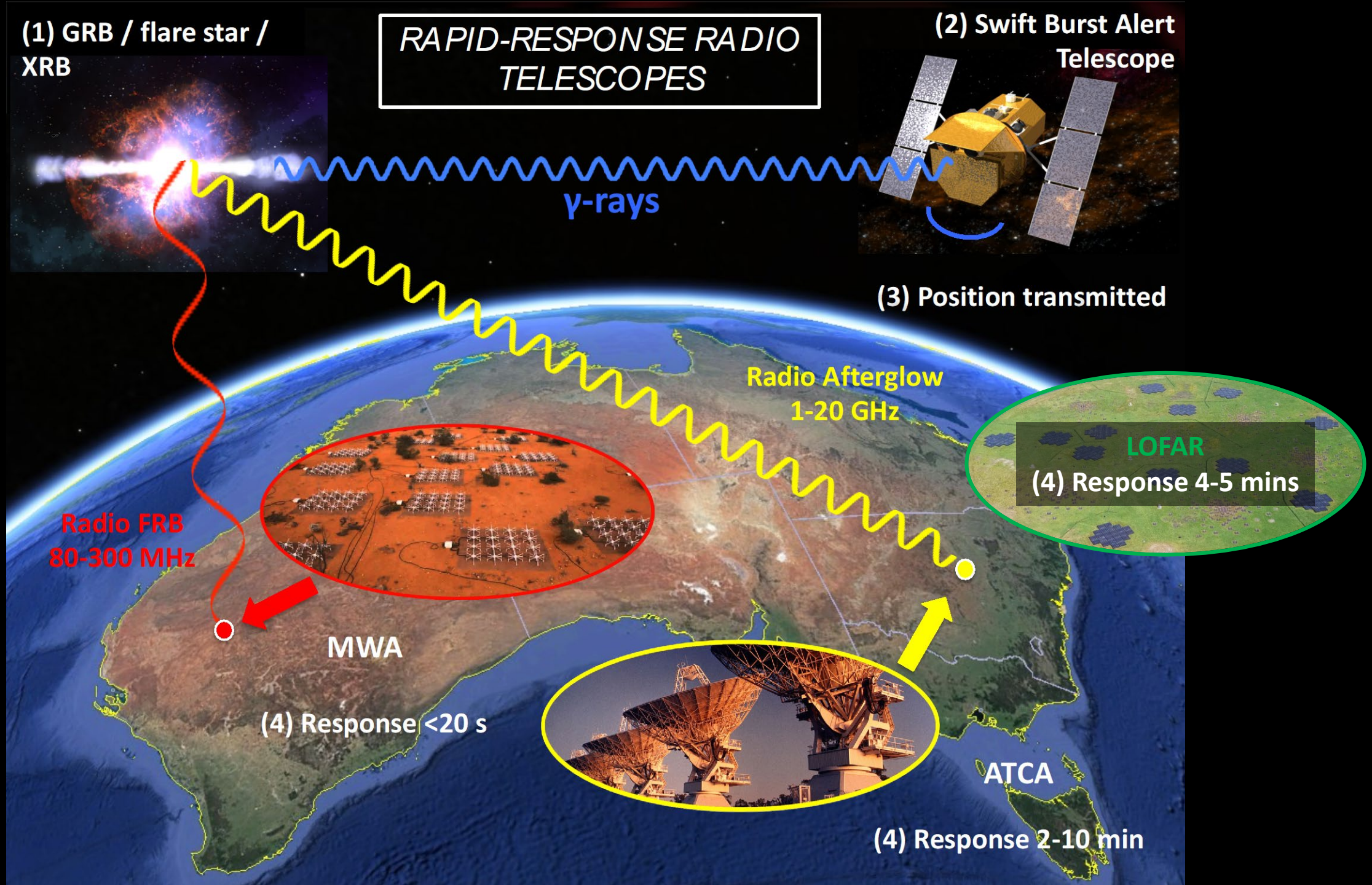

ATCA Science Day, 8 April 2025

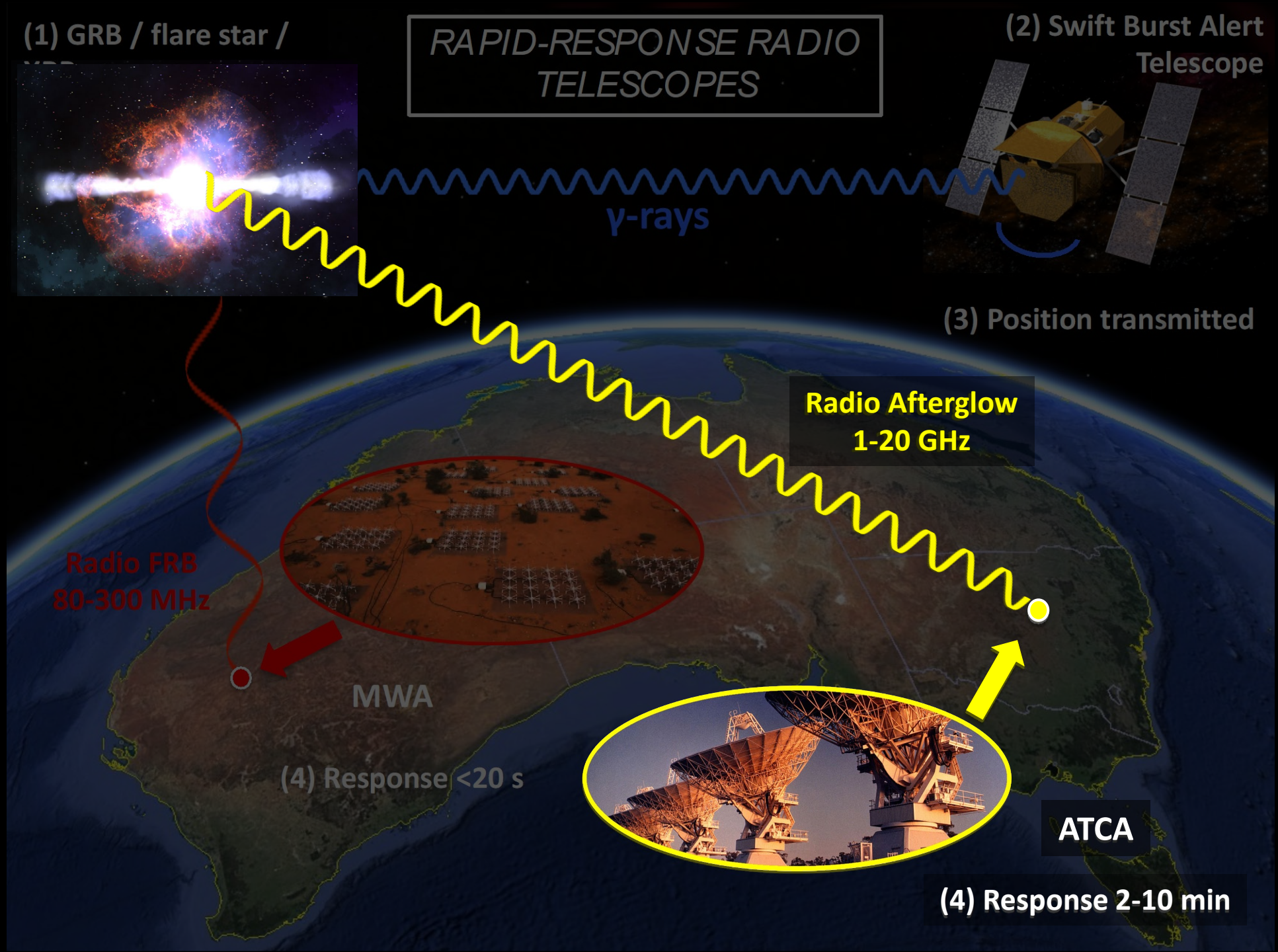
ICRAR International Centre for Radio Astronomy Research

Curtin University

THE UNIVERSITY OF WESTERN AUSTRALIA

Government of Western Australia
Department of the Premier and Cabinet
Office of Science


(1) GRB / flare star / XRB
RAPID-RESPONSE RADIO TELESCOPES
(2) Swift Burst Alert Telescope
γ-rays
(3) Position transmitted
Radio Afterglow 1-20 GHz
LOFAR
(4) Response 4-5 mins
Radio FRB 80-300 MHz
MWA
(4) Response <20 s
ATCA
(4) Response 2-10 min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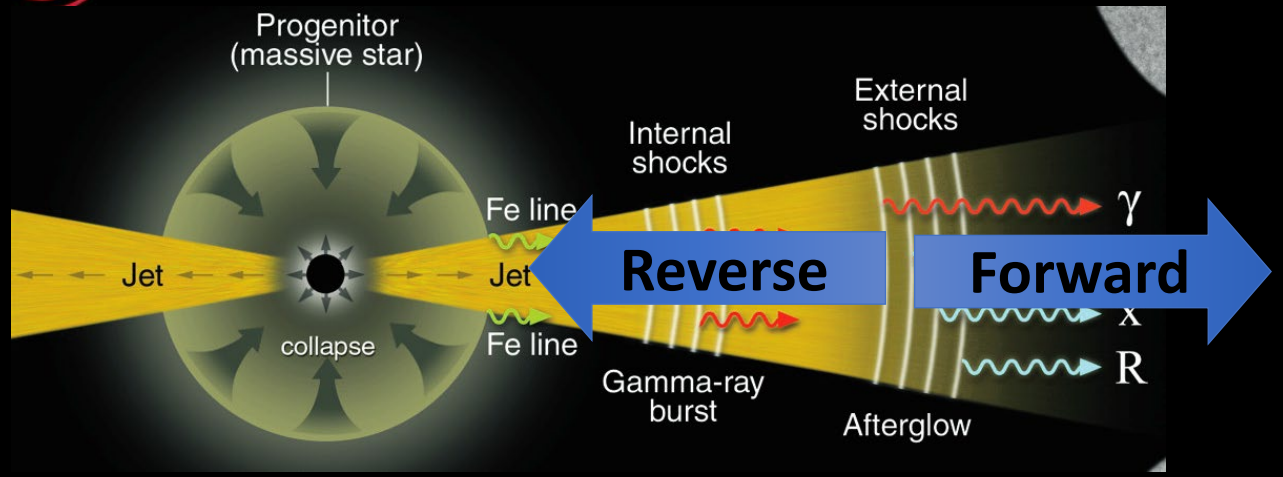
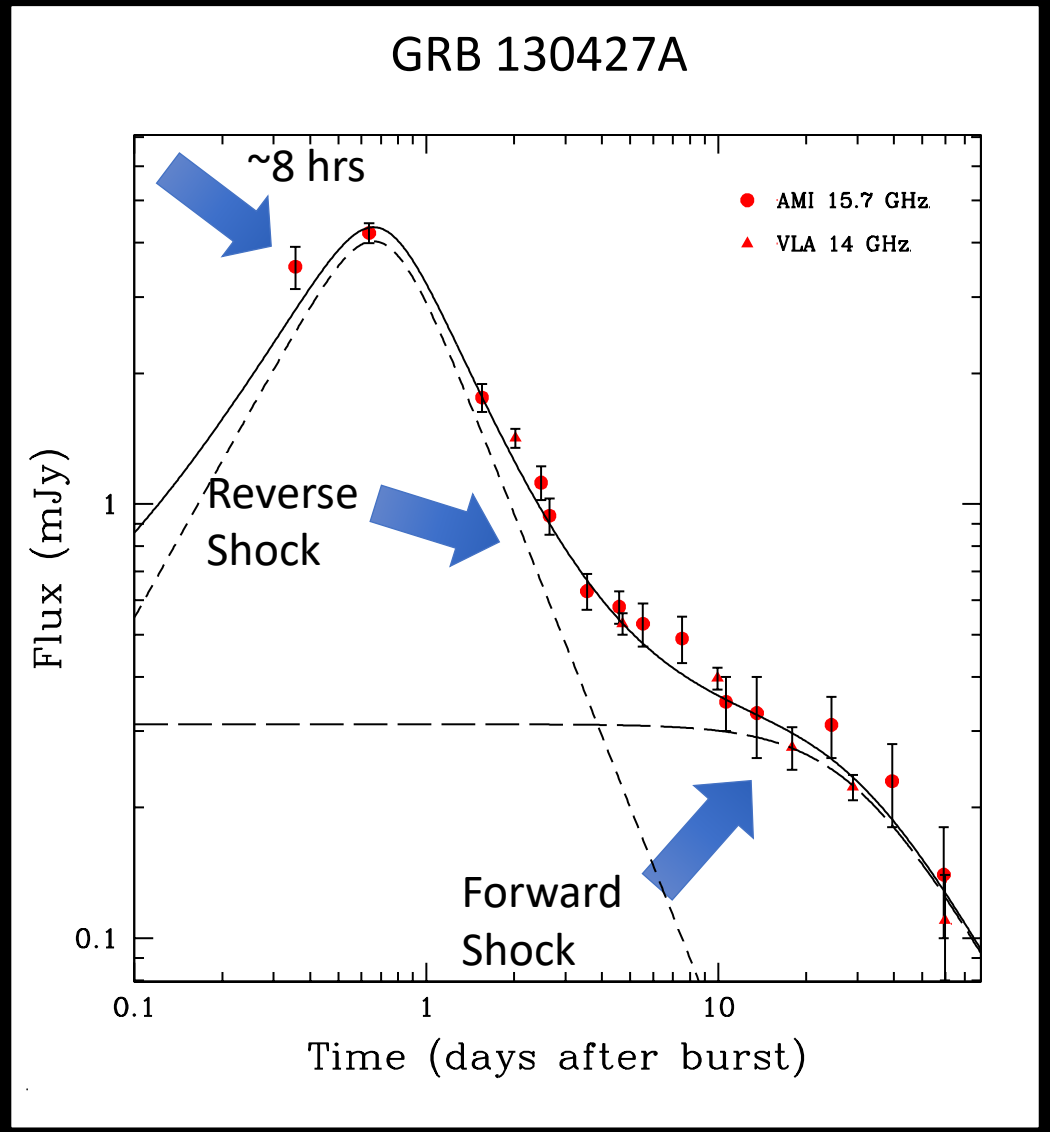
# Science Cases for rapid-response

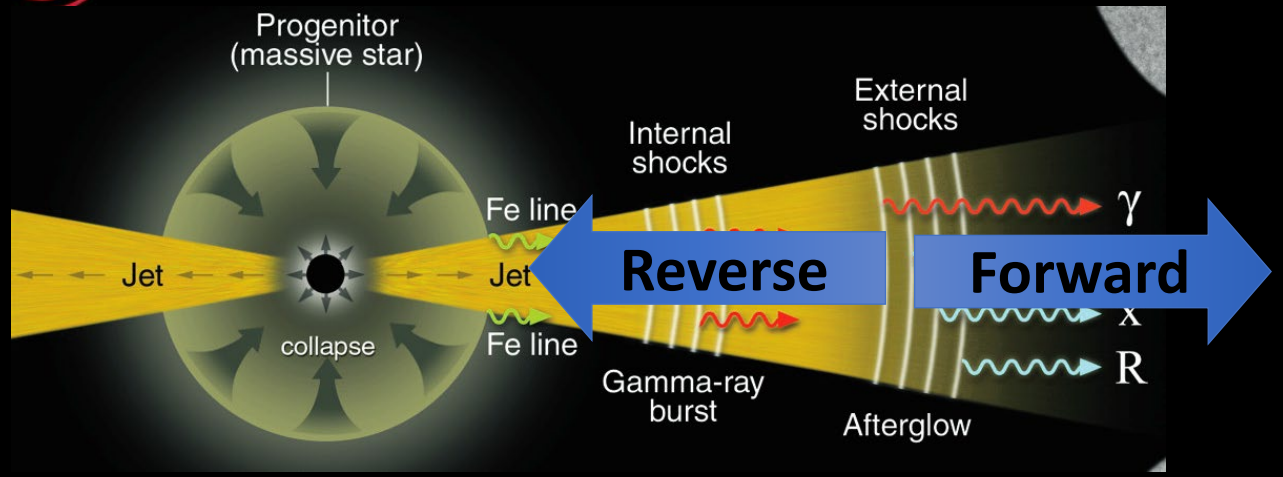


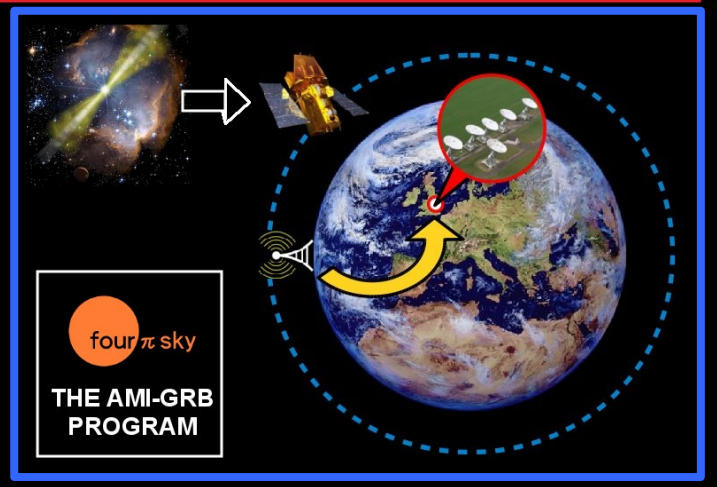

- Gamma-ray Bursts (GRBs)
  - Reverse shock – probe outflow composition
  - Central engine – energy injection, magnetar
- Flare stars
  - Gyrosynchrotron emission
  - Coherent emission mechanisms
- X-ray binaries – $L_X$-$L_R$ evolution
- LSST transients
  - Supernova shock break-outs?
- Multi-messenger transients – LVK, CTA




Anderson et al. (2014), MNRAS, 440, 2059

# Science Cases for rapid-response

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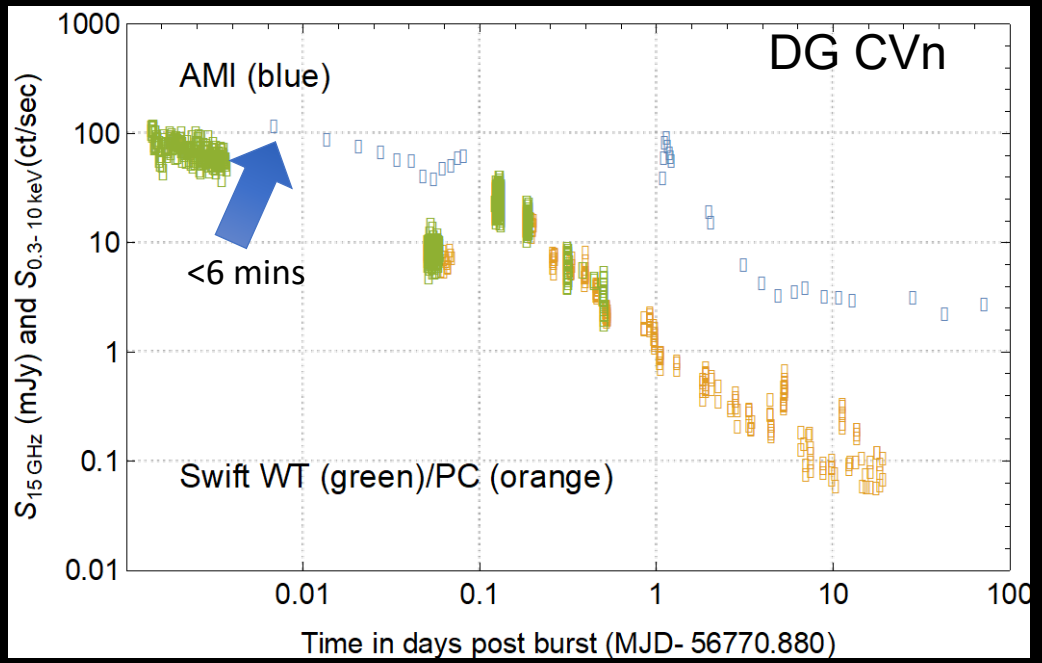
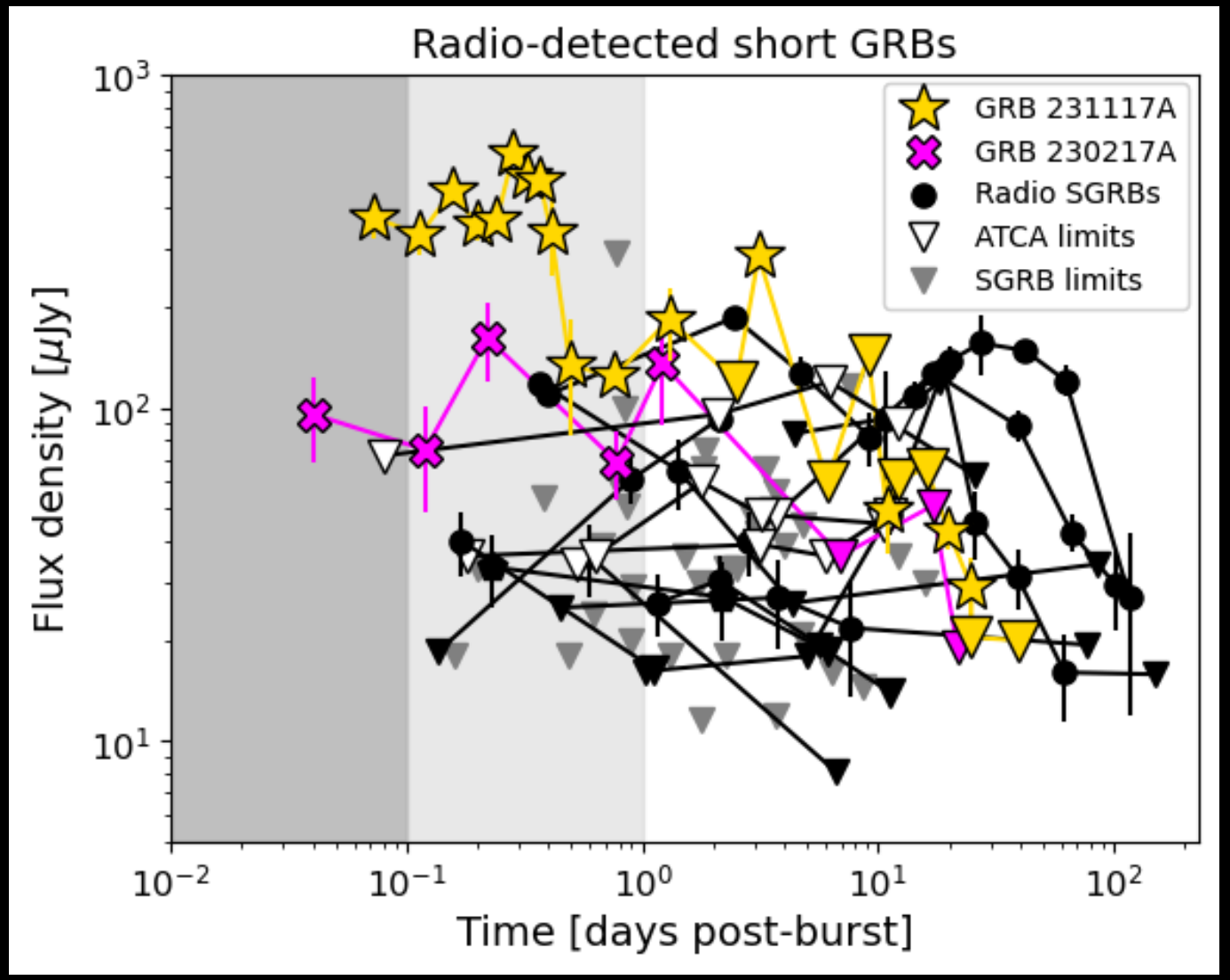



Fender et al. (2015), MNRAS, 446, L66

# ATCA's Unique Capability

1. Only rapid-response telescope at GHz frequencies
   - Slew time 1-10 mins
   - Phase cal observation
   - Its **interruptibility**




Anderson et al. (2024), ApJL, 975, 13; Chastain et al. (2024), MNRAS, 532, 2820; Anderson et al. in prep

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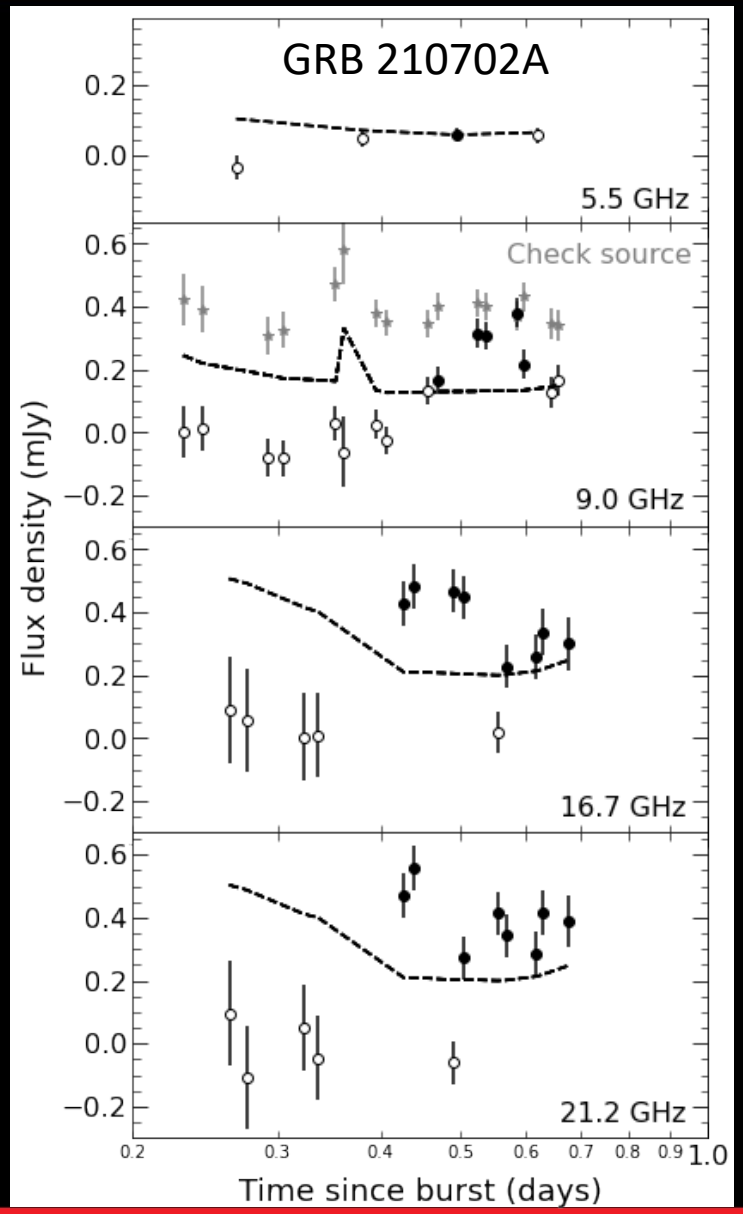
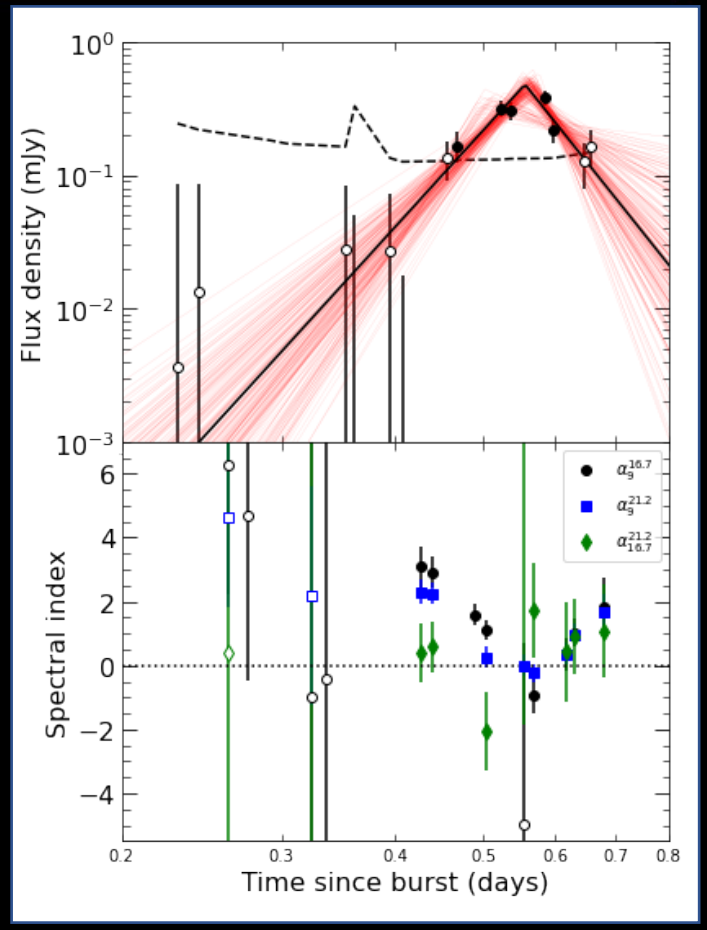
2. Large instantaneous bandwidth:
   - BIGCAT: 8 GHz – most competitive
   - Polarisation
   - VLA: 4 GHz
   - SKA-Mid: 700 MHz – 5 GHz




Anderson, et al. 2023, MNRAS, 523, 4992

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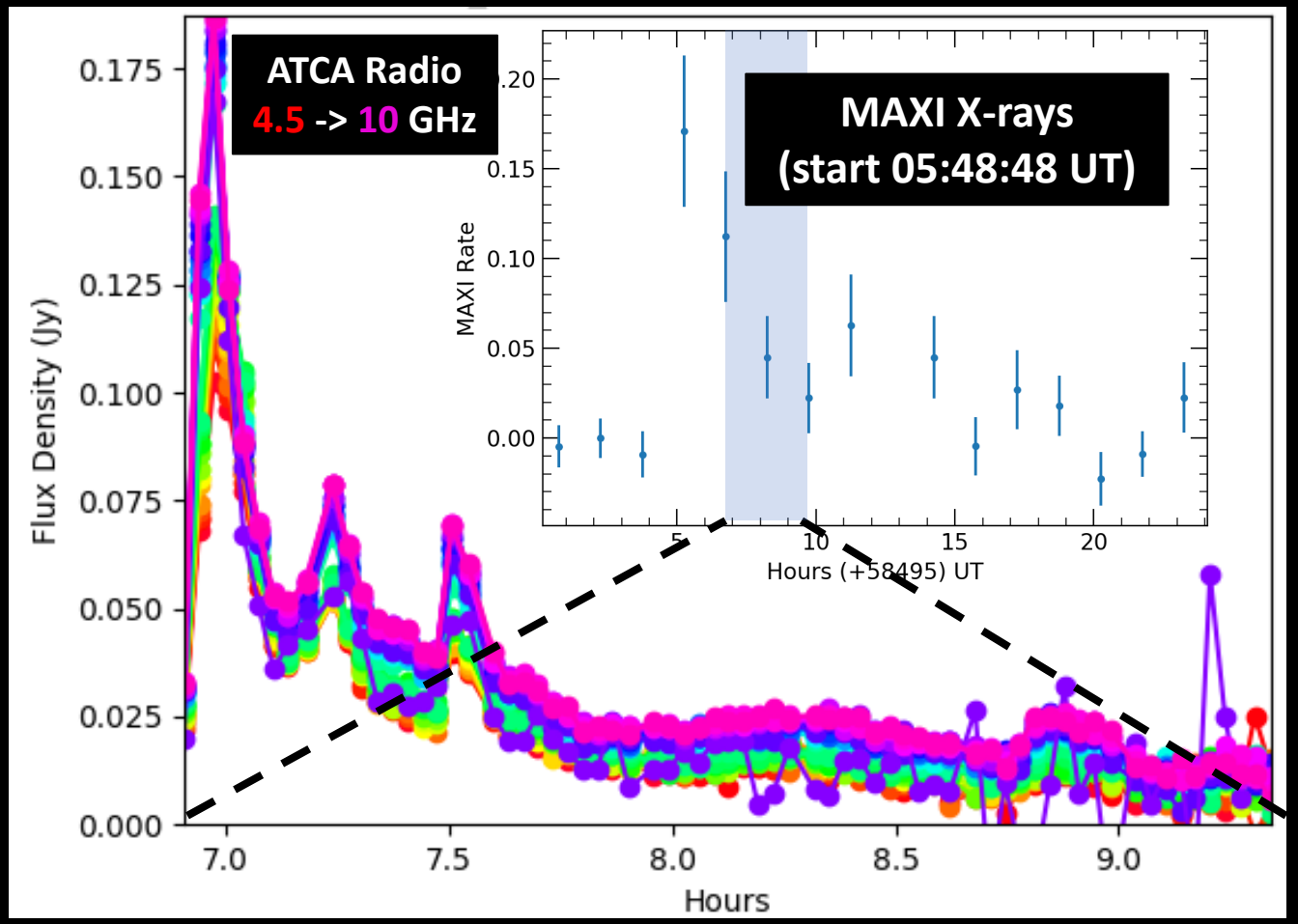
AT Mic: ATCA trigger on MAXI-detected flare




Credit: Daniele d'Antonio

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3. Designed for longer integrations
   - East-West array
   - Can justify up to 12 hours
   - VLA: ~3 hour triggers

GRB 240205B

Chastain et al. in prep

# ATCA in the SKA era

- Rapid-response unique at GHz frequencies until SKA-Mid
  - First steps to fully automated observing
- A dedicated transient machine
  - Transient SKA-Mid dedicated subarray?
    - Could ATCA do this?
  - SKA transient follow-up?
    - Rapid-response
    - Long term multi-frequency follow-up
  - A second North-South spar at 2 or 3 km
    - Rounder beam
    - Shorter integrations for transient snap shots