Pan-Radio GRB: An automated triggering program and long-term radio follow up program for Swift GRBs with ATCA

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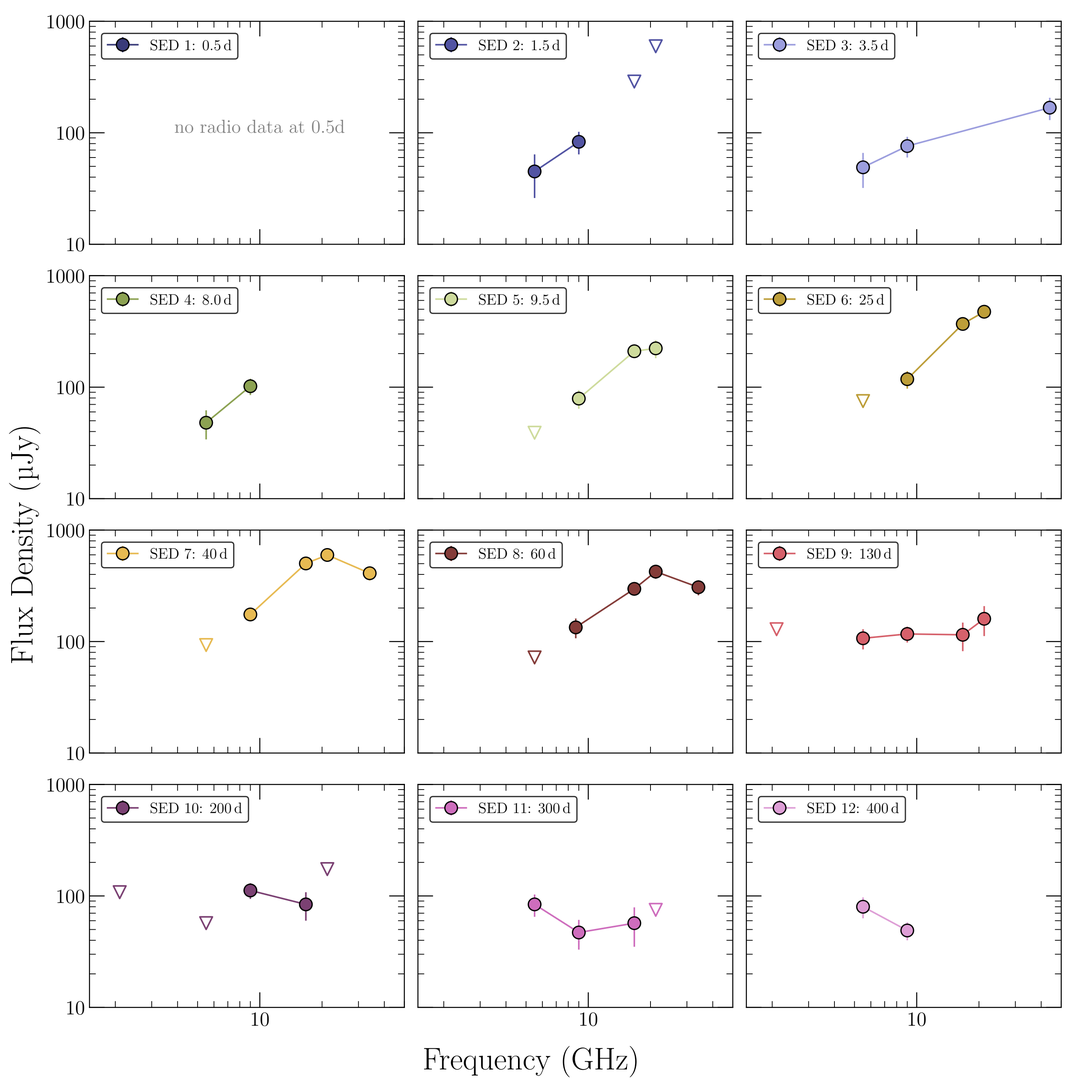
Motivation & Observing Plan

- Gamma-ray bursts (GRBs) provide the most extreme window into the fastest observed outflows, which are relativistic and highly collimated (i.e. jets).
- When a jet interacts with the surrounding environment, external shocks are produced (called reverse and forward shocks due to their relative directions) and emit synchrotron radiation detectable at radio frequencies.
- GRBs in the literature have usually been cherry-picked for radio follow-up based on known properties
  - high gamma-ray fluence,
  - the existence of an optical and/or X-ray counterpart,
  - low redshift,
- This has limited our exposure to interesting GRBs (e.g. "dark" bursts) and a full understanding of their intrinsic properties and local environments.
- Our observing program on the Australian Telescope Compact array is trying to change this by placing radio observations at the forefront independent of the multi-wavelength burst properties.
- GRB 230815a demonstrates ATCA's broadband spectral coverage 1.3 to 45GHz and the long-term monitoring part of the program
- GRB 240204b and the short GRB compilation shows the importance of the rapid response mode that resulted in detections within the first 30 minutes post-burst.

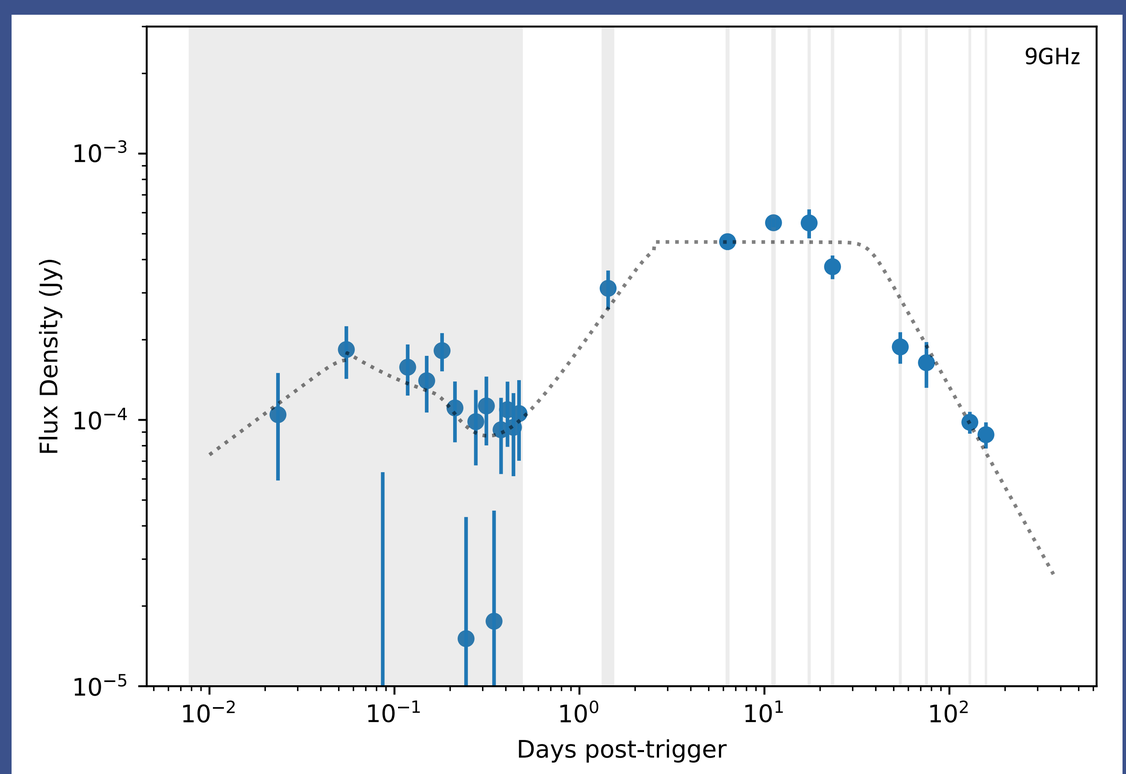
Observing Plan

1. Early characterisation:
   <24hrs to 1 week post-burst
2. Mid-time confirmation
   10 -15 days
   In the case of good optical and x-ray coverage
3. Long term monitoring
   15 – 60 days
4. Late time observations
   > 60 days
   Tracking into a non-relativistic regime

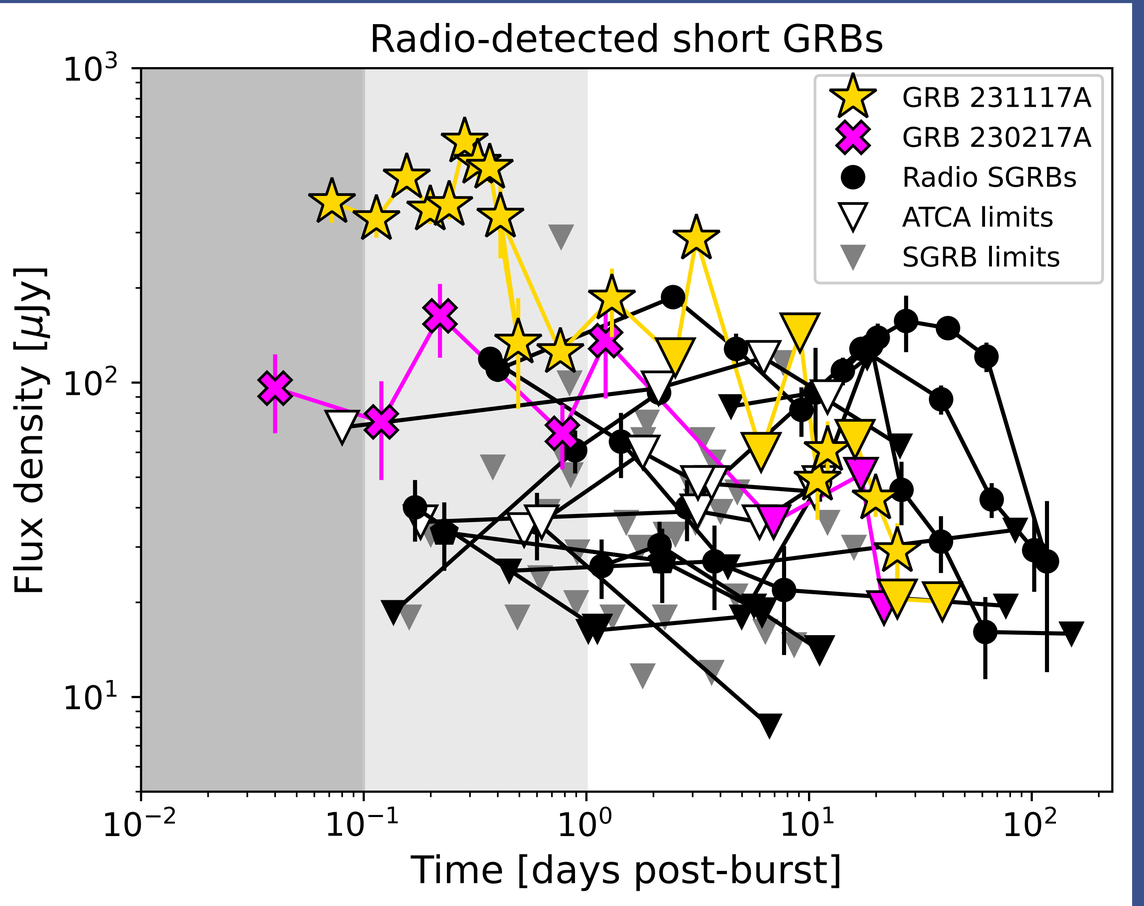
Long GRBs – GRB 230815a



Long GRBs – GRB 240204b



Short GRBs



Implications of our campaign

- We are detecting radio emission from both short and long GRBs are early as minutes post-burst allowing us to constrain the jet hydrodynamics at the earliest times.
- We are calculating the radio luminosity function for GRB afterglows independent of their multi-wavelength properties.
- We are observing a broad range of GRB afterglow properties, in particularly their electron energy spectral index and their environments.
- We are tracking the afterglows out to later times to better constrain system geometries.

Relevant references: Anderson G.E., et al., 2023, MNRAS, 523, 4992; Anderson G.E., et al., 2024, ApJL, 975, L13; Chastain et al. 2024, MNRAS, 532, 2820; Levan et al. 2024, Nature, 636, 737 ; Rhodes et al. 2024, MNRAS, 533, 4435; Giarratana et al. 2024, A&A, 690, A74