Lessons learned from the AT20G:

The importance of innovation, mentoring, and getting it right.

Dr Paul Hancock

ICRAR — International Centre for Radio Astronomy Research
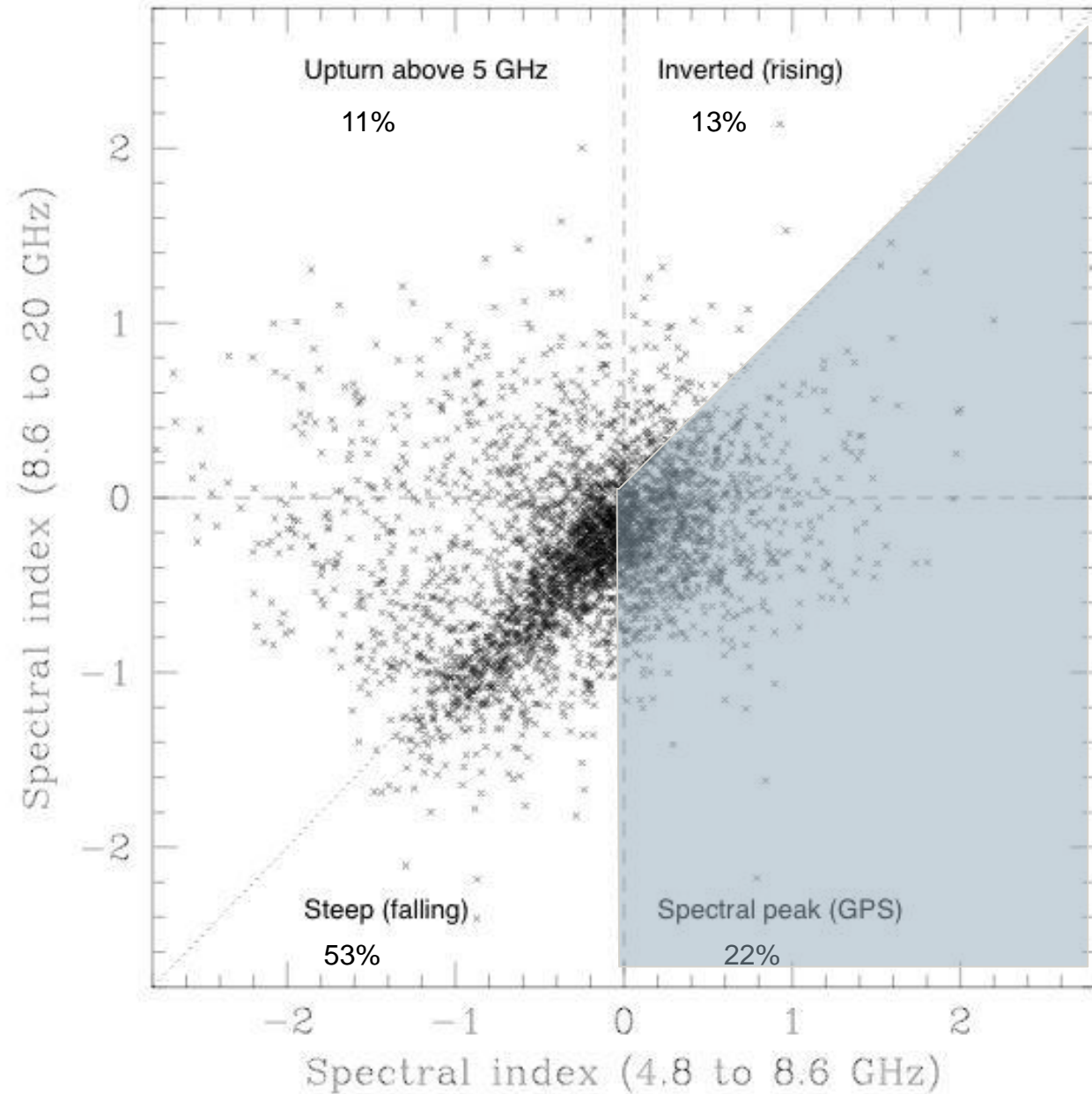
Curtin University

THE UNIVERSITY OF WESTERN AUSTRALIA — *Achieve International Excellence*
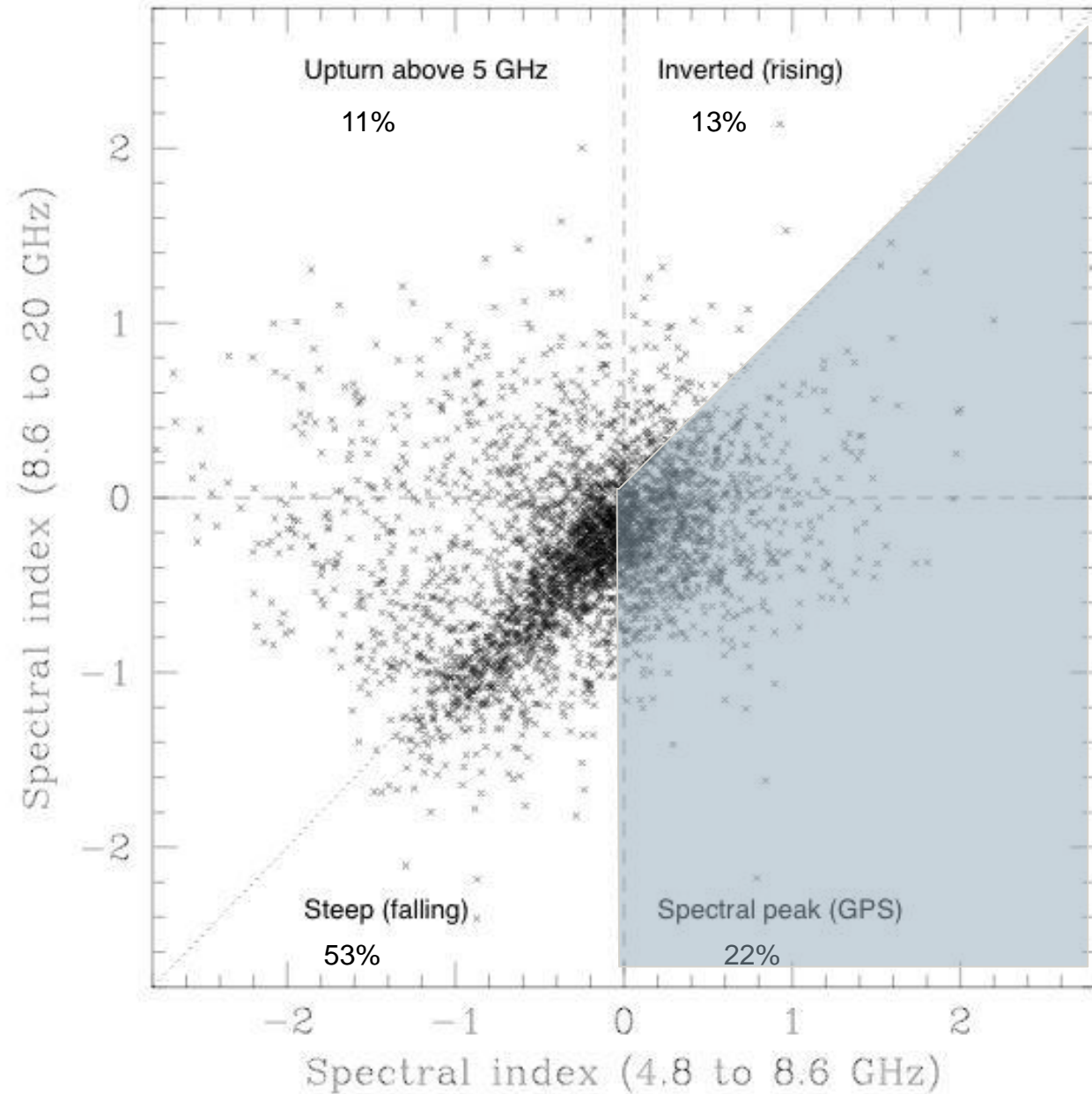
My PhD

- Measure fluxes at 5/9/20GHz

- Make a colour-colour plot

- Select the GPS sources

- eVLBI + optical follow-up

- Discover cool things

My PhD

- Measure fluxes at 5/9/20GHz   80%

- Make a colour-colour plot
- Select the GPS sources
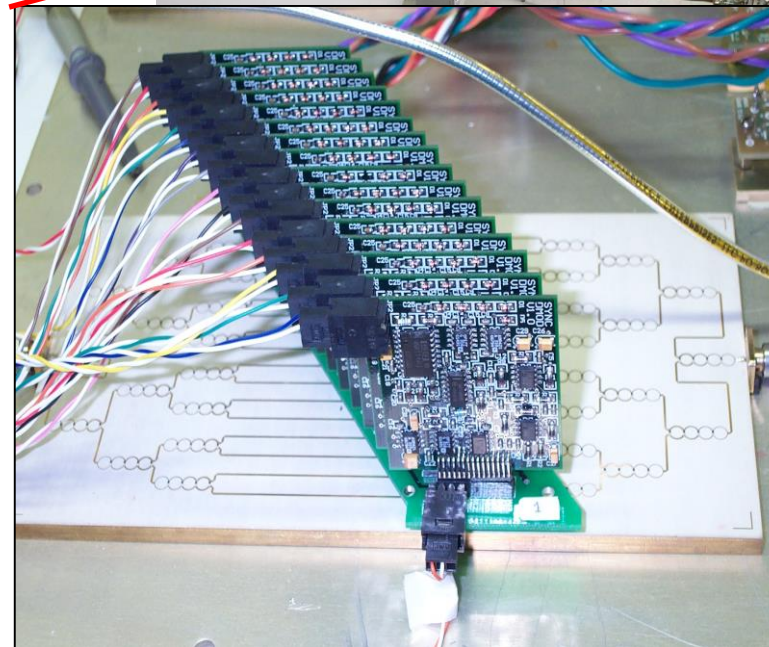- eVLBI + optical follow-up   20%
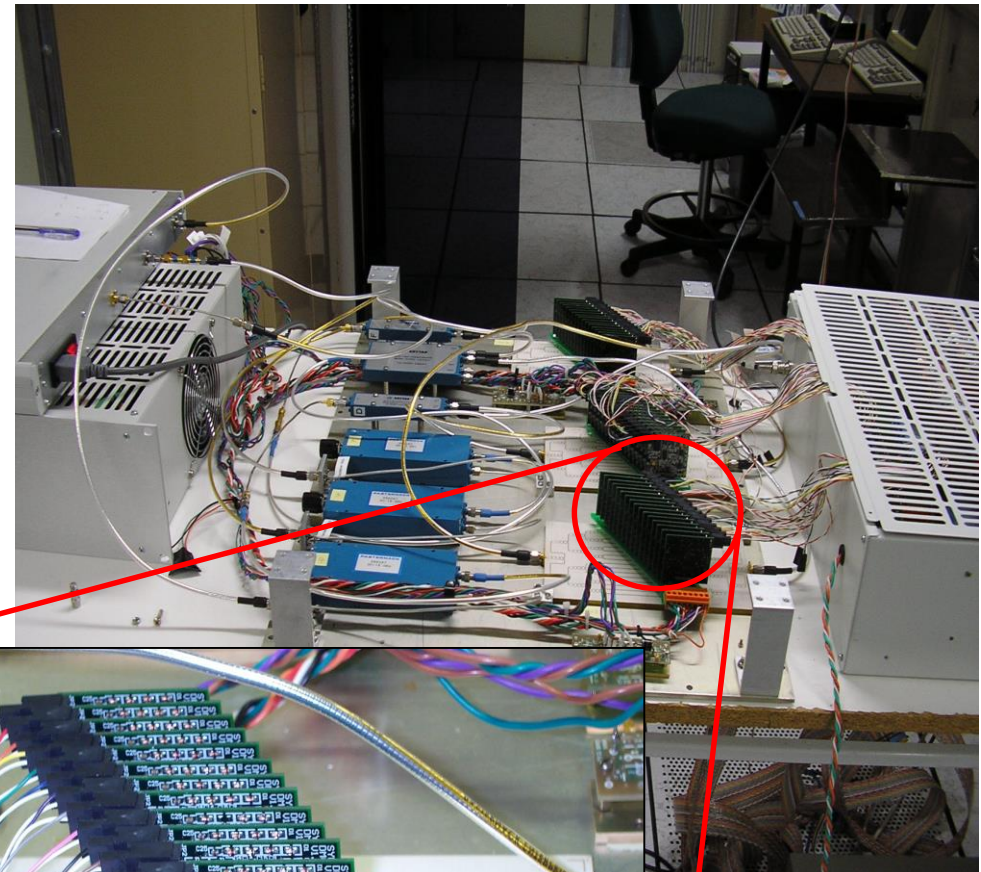- Discover cool things

AT20G Hardware

WBAC

- 8GHz bandwidth

- 16 delay channels (not perfectly spaced)

- 3 baselines

- 54ms sampling rate

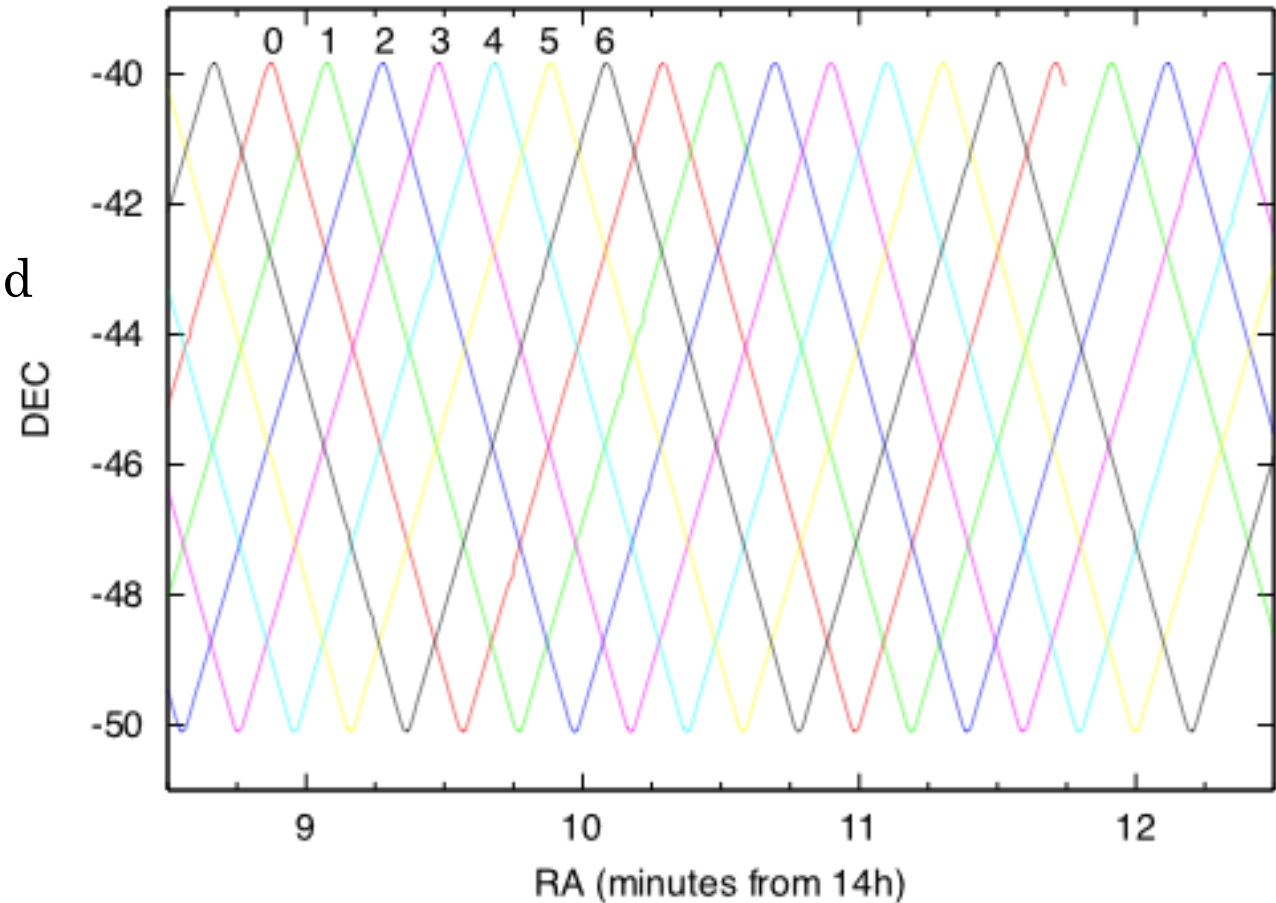- Simultaneous *analog* correlation

- No delay tracking

ATCA

- Antennas 2,3,4

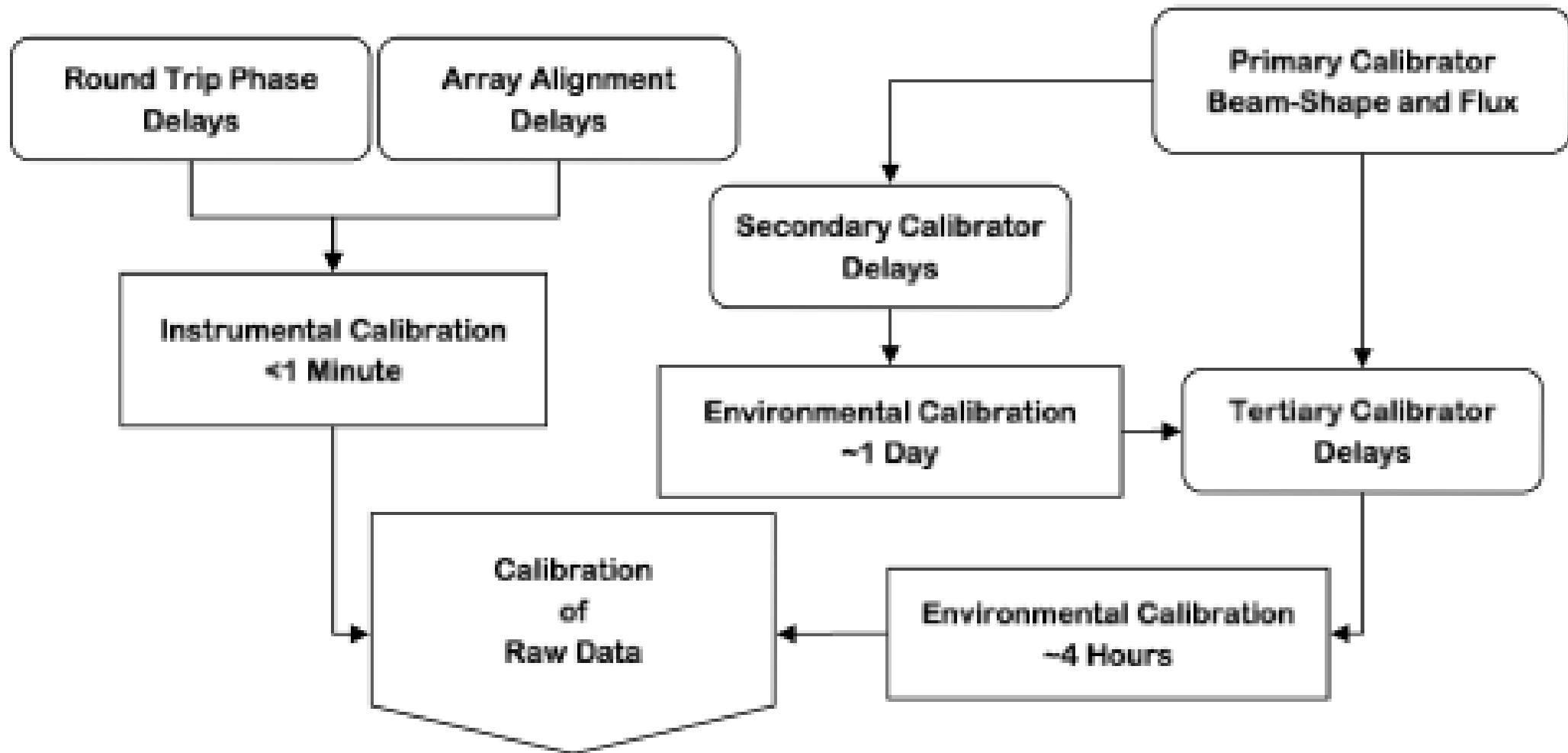- 15°min^{-1} scan rate
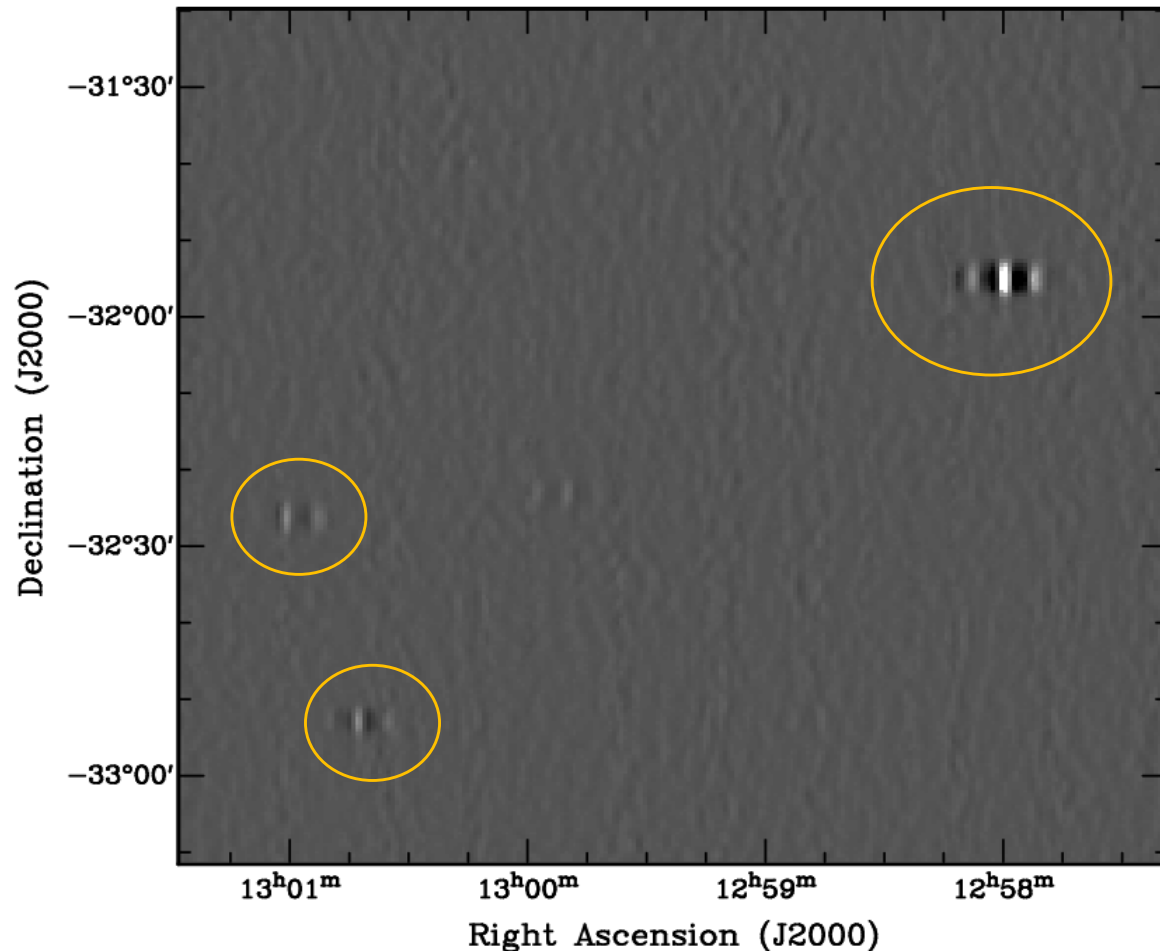
- Observing at 20GHz

Observing Strategy

- Delays fixed on the meridian

- Telescopes scan N-S

- Sky rotates E-W

- Successive tracks are interleaved to cover the sky

- Interleaves used to create sky maps

- Observe a 10° dec band per observing run

- Follow up with regular ATCA obs/corr @ 5/9/20GHz

Interleave Calibration

Map Making

- Imaging: OTF mosaicking

- Source finding: Matched filter

- Initially positions and fluxes were inaccurate

- Reliability was initially low
  - Many candidates
  - Few real sources

- Accuracy and reliability increased by filtering candidate sources and refining calibration scheme.
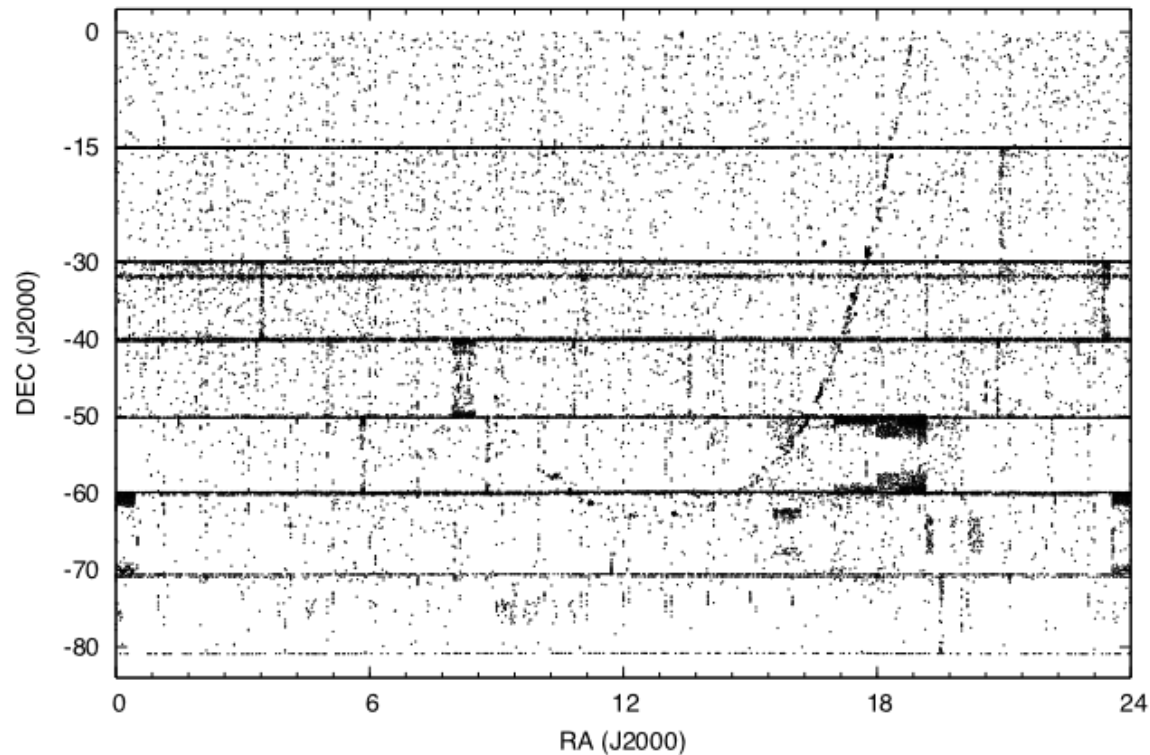
Candidate Source Filtering

- Compare to NVSS/SUMSS/MGPS2 surveys to guide filtering
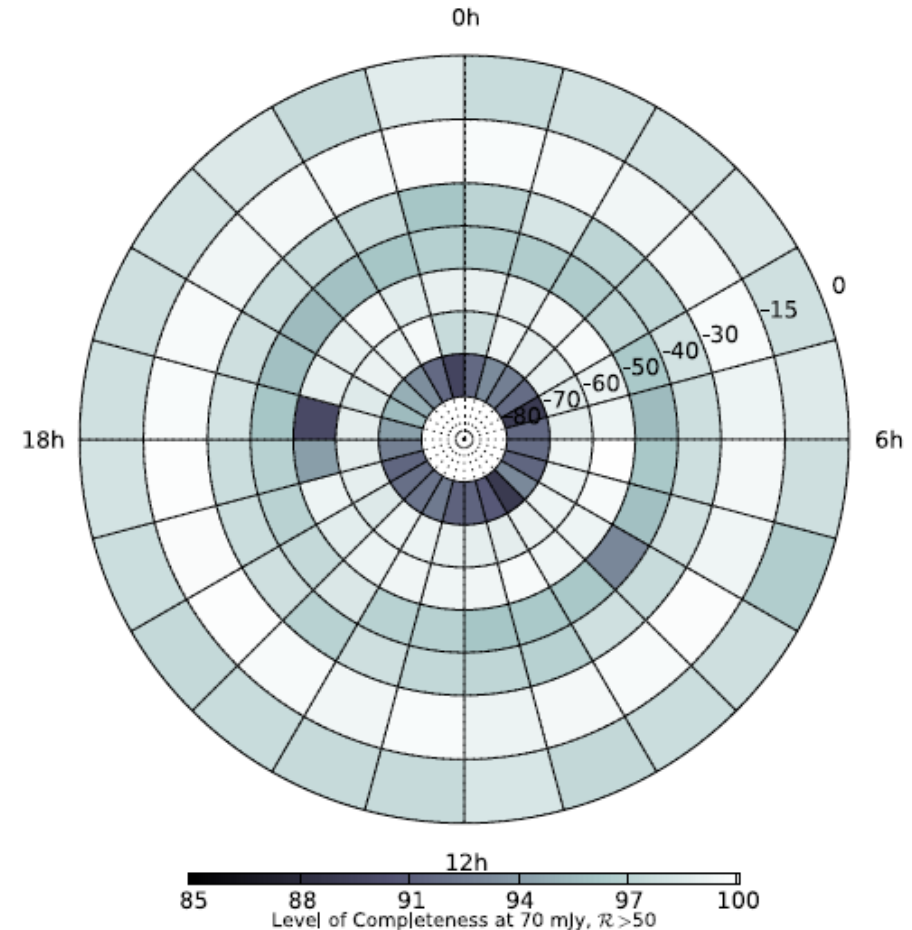
Matched
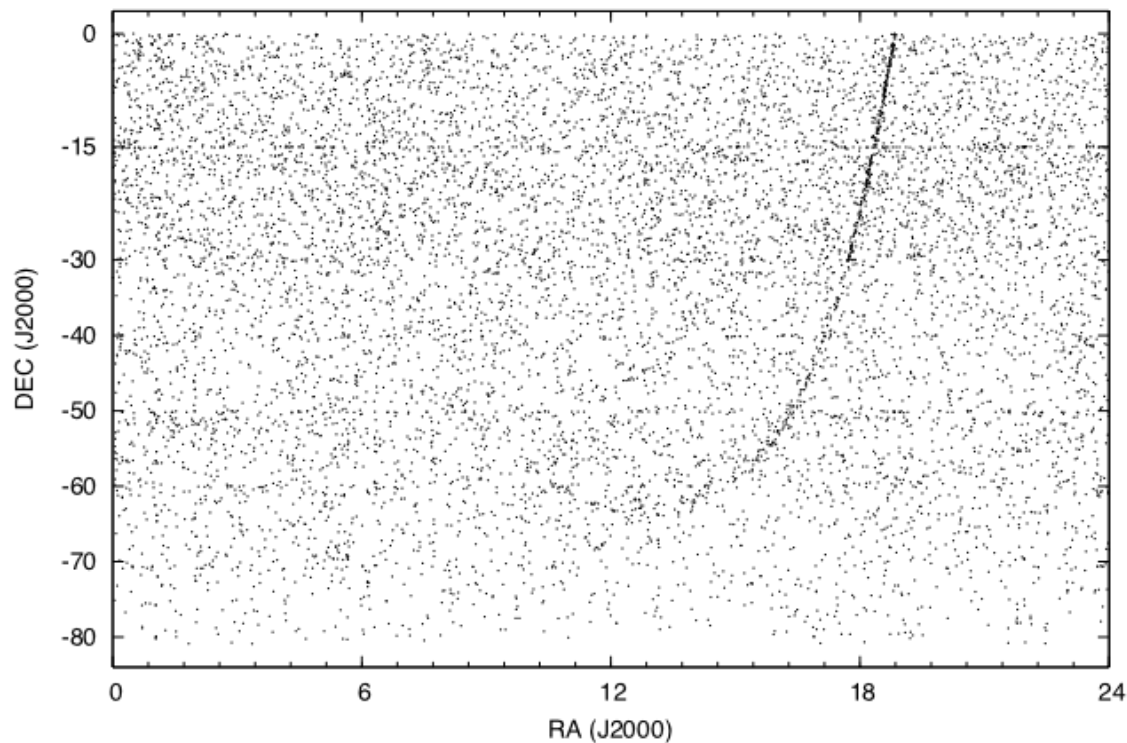
Unmatched

Scanning survey Completeness

- Inject sources into data stream

- Run calibration/imaging/source finding

- Recover sources

- Custom cal/img/sf codes mean we could inject sources before calibration

- This is why a deep knowledge is useful

Level of Completeness at 70 mJy, $\mathcal{R} > 50$
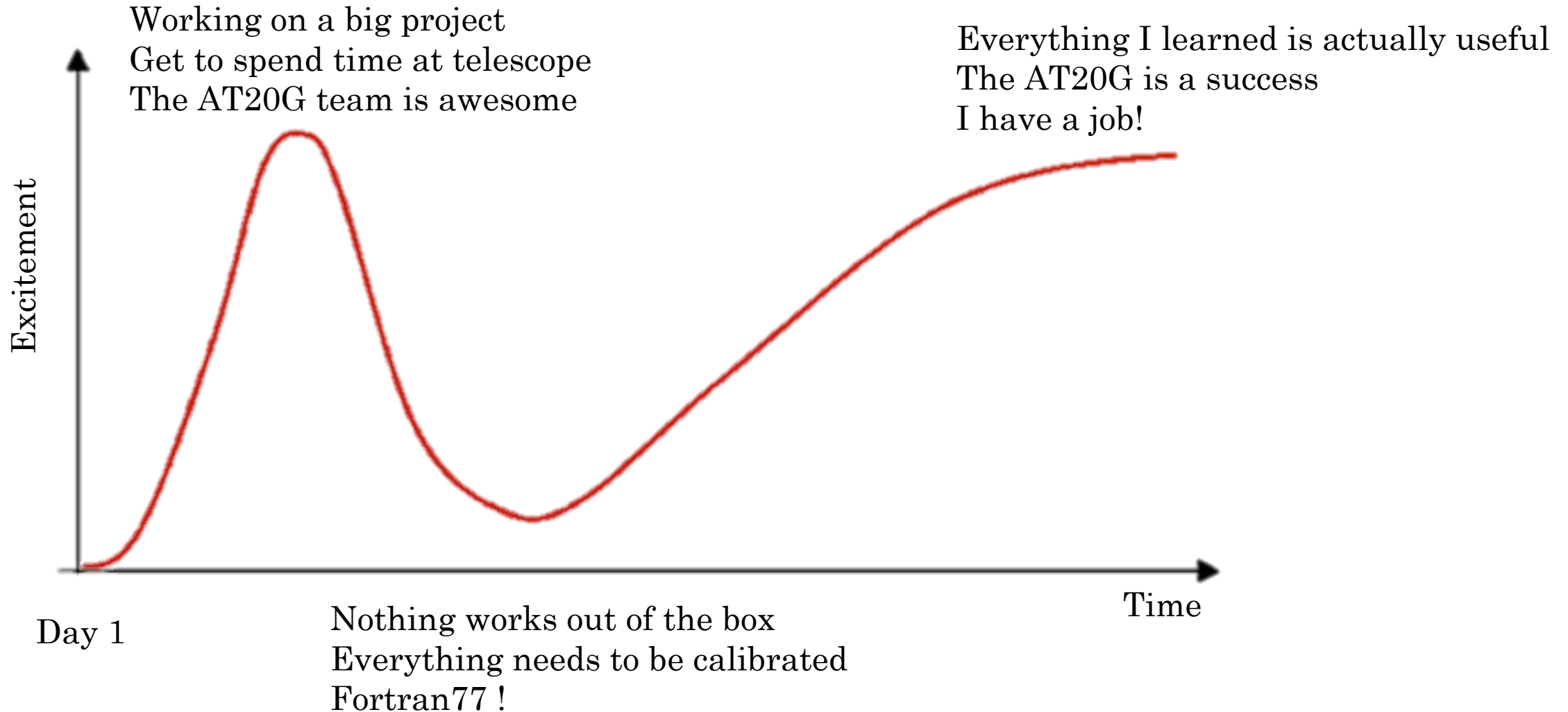
Learning with the AT20G

- Narrabri was THE place to learn

- Analogue correlator

- Experts with time/patience
  - Ron, Elaine, Mike, Robin, Jamie, Phil
  - + many visitors

- ATCA tours, reconfigs, "helping" maintenance

- Custom coded:
  - OTF mapping
  - source finding
  - completeness/reliability
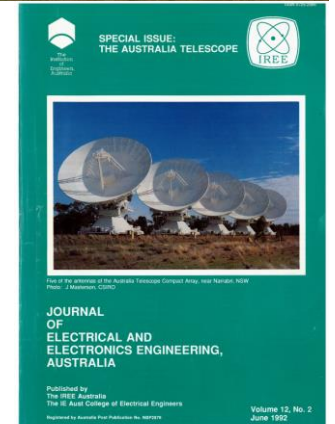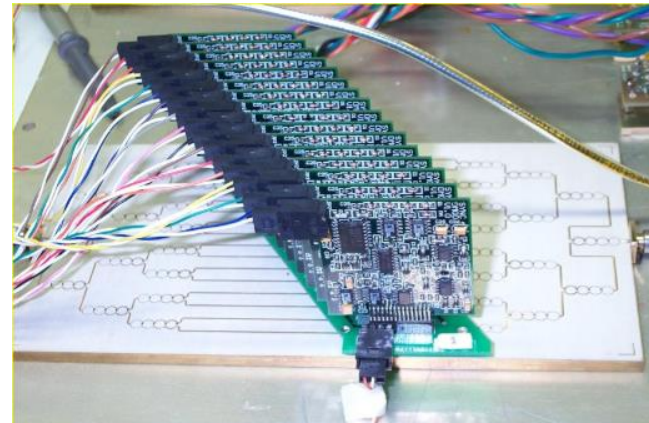
My experience with AT20G

- Everything was hard

- We had to make all our own tools

- No one complained

- Problems are challenges / teaching moments

- Critical jobs were given to me (!)

- I thought this was just normal

- Realised later that it was not

My experience with AT20G

Working on a big project
Get to spend time at telescope
The AT20G team is awesome

Everything I learned is actually useful
The AT20G is a success
I have a job!

Excitement

Time

Day 1

Nothing works out of the box
Everything needs to be calibrated
Fortran77 !

My work today

- Building tools for astronomy
  - Aegean source finder and AegeanTools

- Source finding/cataloguing for GLEAM

- Transient/variable surveys with the MWA

- Fireballs with the MWA

- ATCA observations of SN/GRB

- Mentoring students (not just my own)

- MWA data reduction workshop

Fireballs with the MWA