THE MURCHISON WIDEFIELD ARRAY (MWA): SCIENCE GOALS, CAPABILITIES, AND STATUS

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MWA Overview

Murchison Wide-Field Array Low Frequency Demonstrator (MWA)

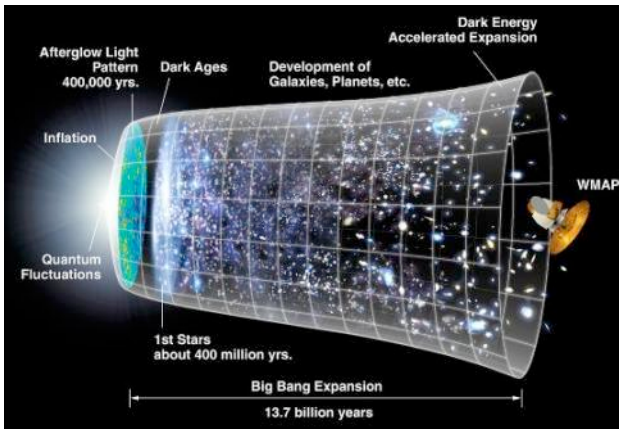
- Murchison area, Western Australia
- 8192 (512x16) dipole antennas over several km^2
- 80-300 MHz (11,000 m^2 collecting area @ 150 MHz)
- 10-50 degree field of view steerable electronically
- US contribution supported by NSF and AFOSR

The Murchison Widefield Array is a joint US-AUS project

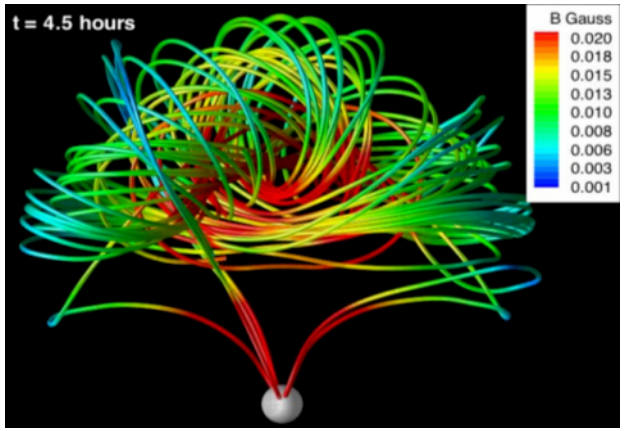
- MIT/Haystack (Alan Whitney, PI), Harvard-CfA, (AFRL, UCSD)
- The Australia Telescope National Facility (ATNF) of CSIRO, Australia
- A consortium of nine Australian Universities led by Melbourne University
- The Office of Science and Innovation (OSI) of the Western Australian Government

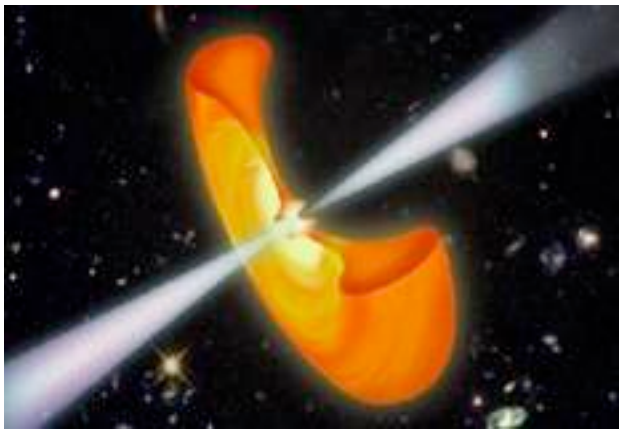
MWA Overall Science Goals

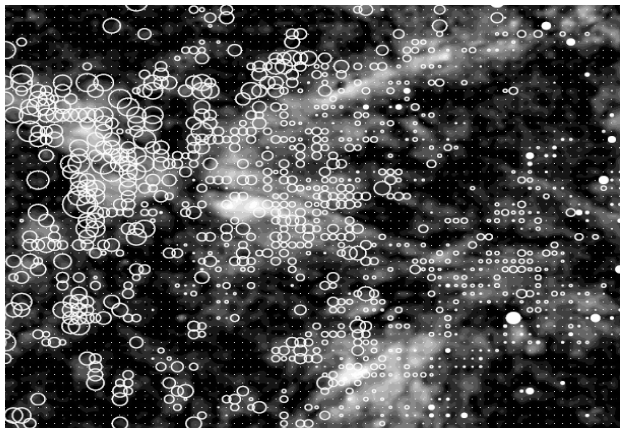
(1) Detect the Epoch of Reionization (EOR)



(2) Track solar eruptions out to 1 AU



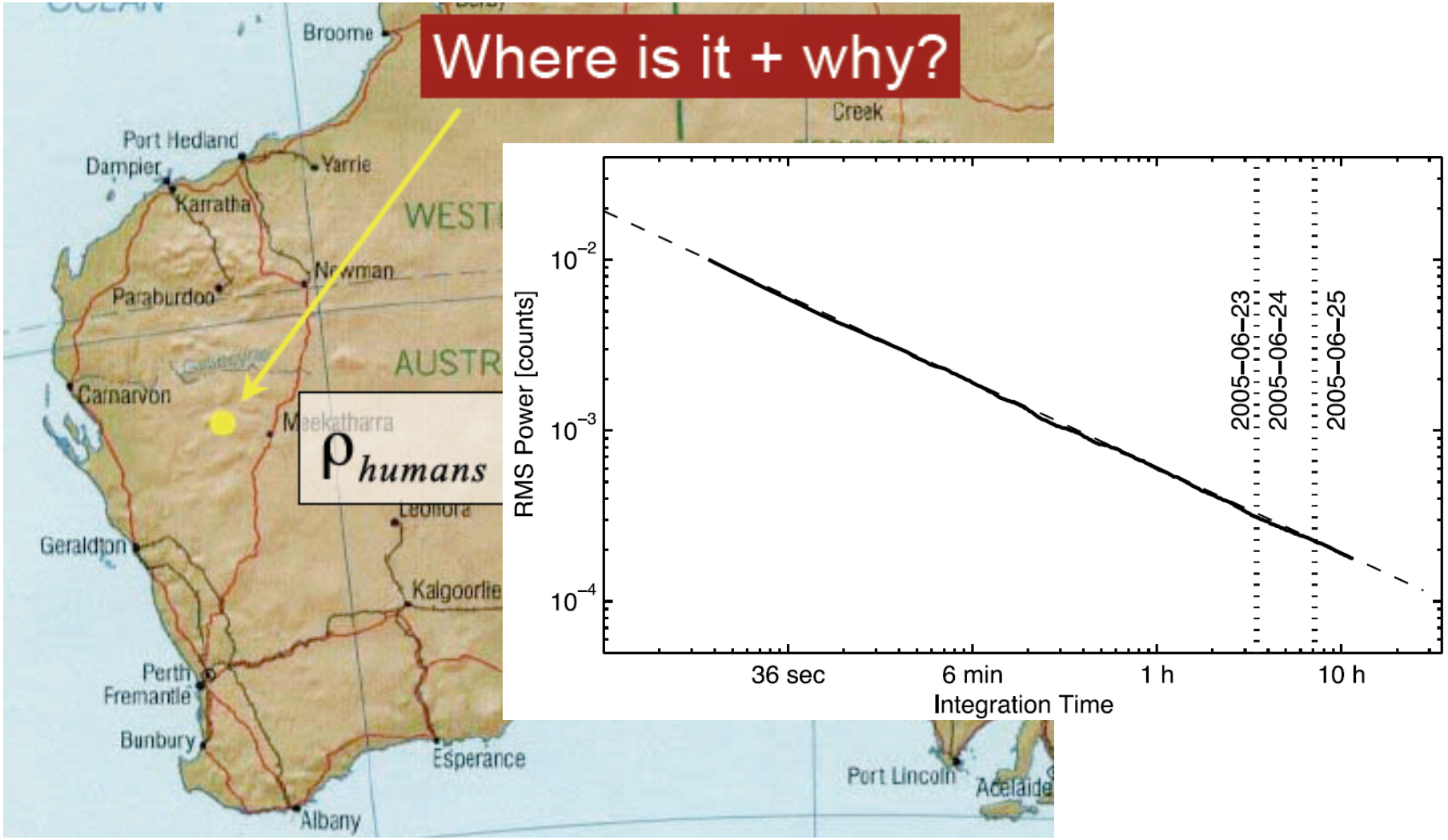




(3) Search for radio transients

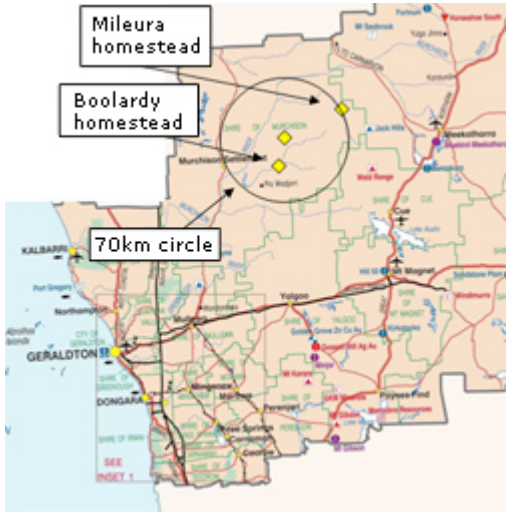
(4) Survey the universe from 80-300 MHz

MWA Location



From Mileura Station to Boolardy Station

Lister Staveley-Smith



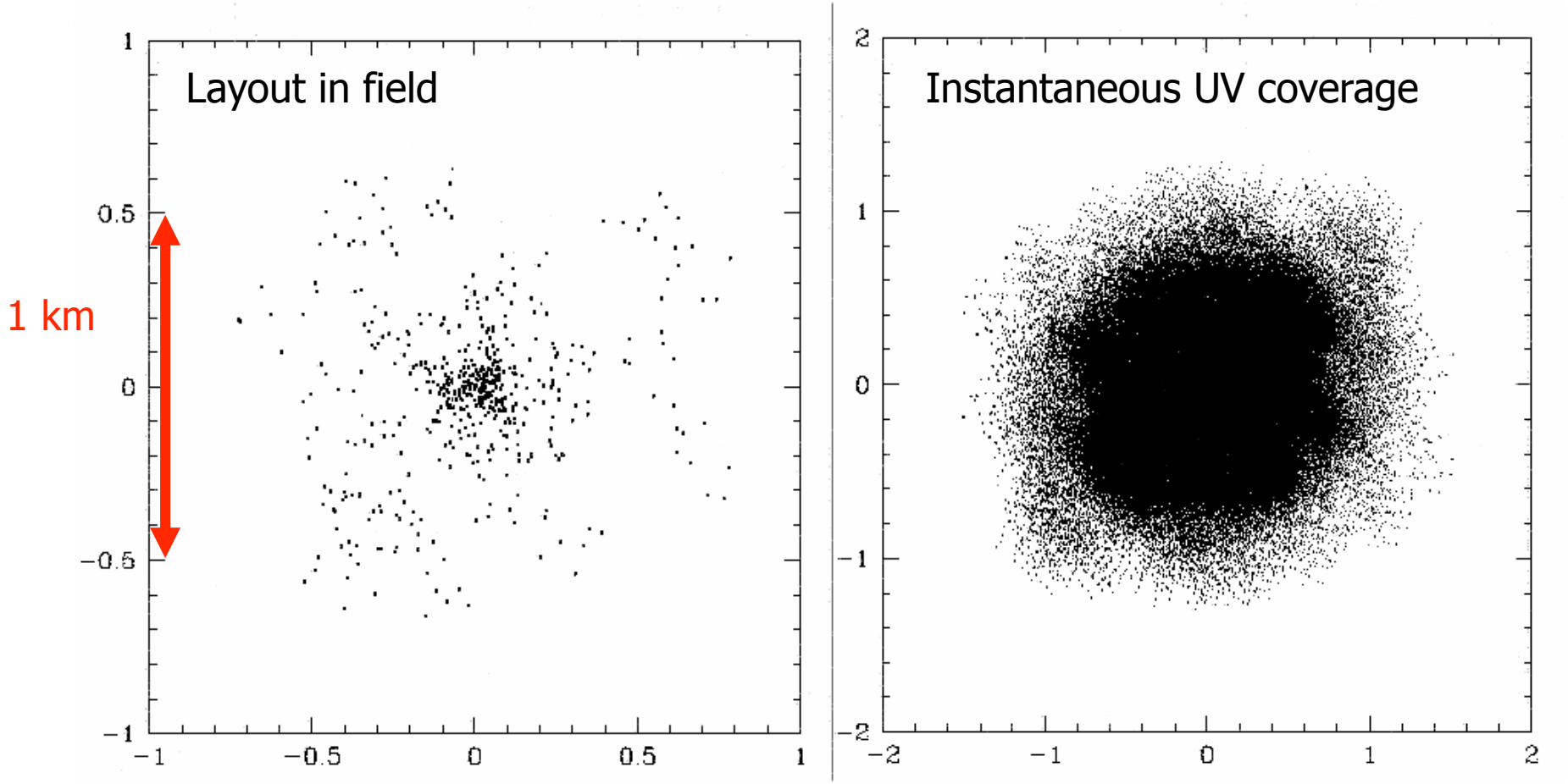
Mileura and Boolardy station are both part of Murchinson Shire

Now the Murchinson Wide-Field Array

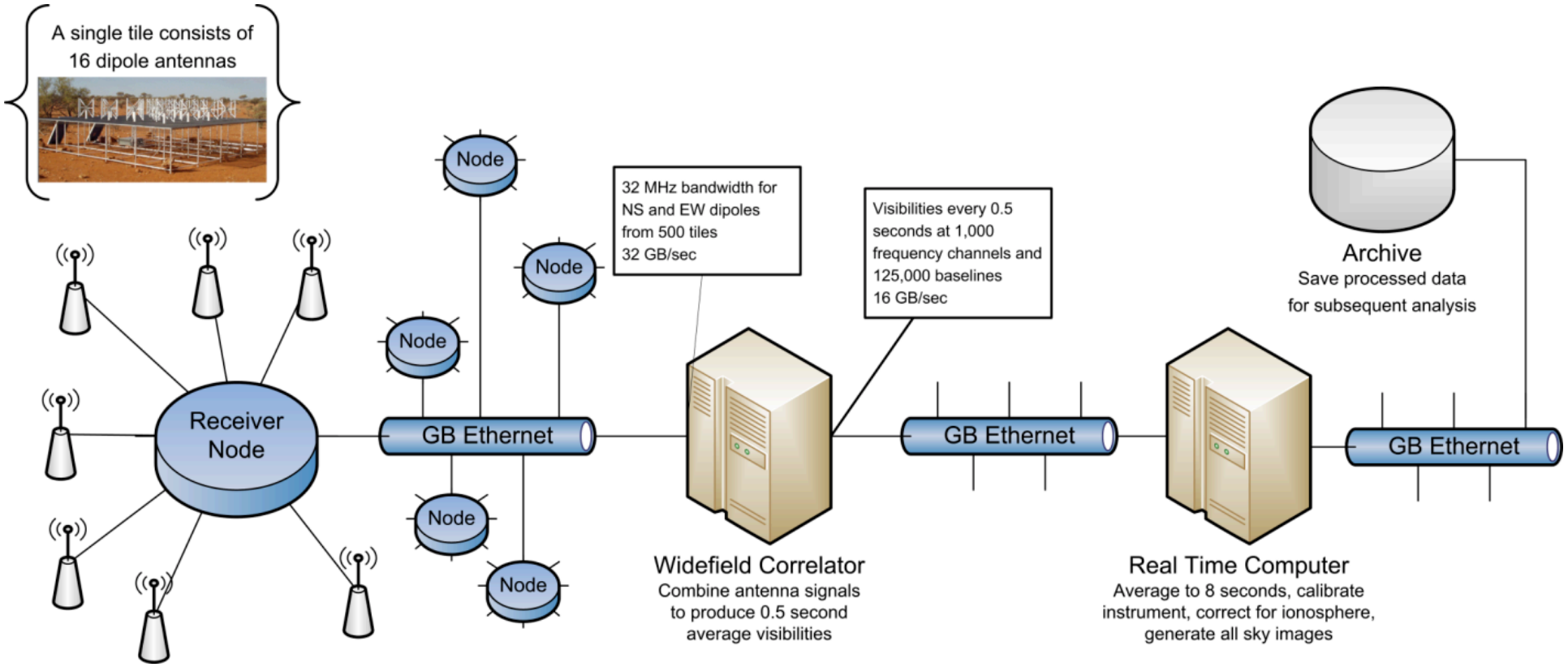
MWA Design: 16-Dipole Tiles

MWA 512T (512 Tiles)

130,816 Interferometer Baselines !

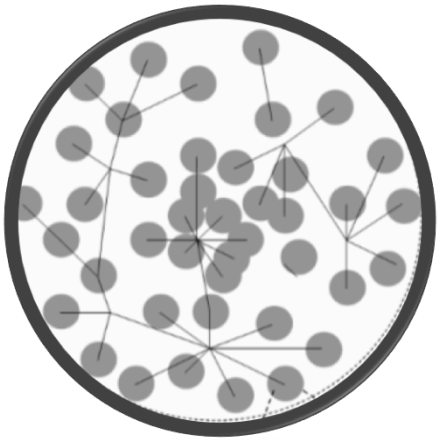


MWA Design: *Array Structure*



MWA data flow

Measurements

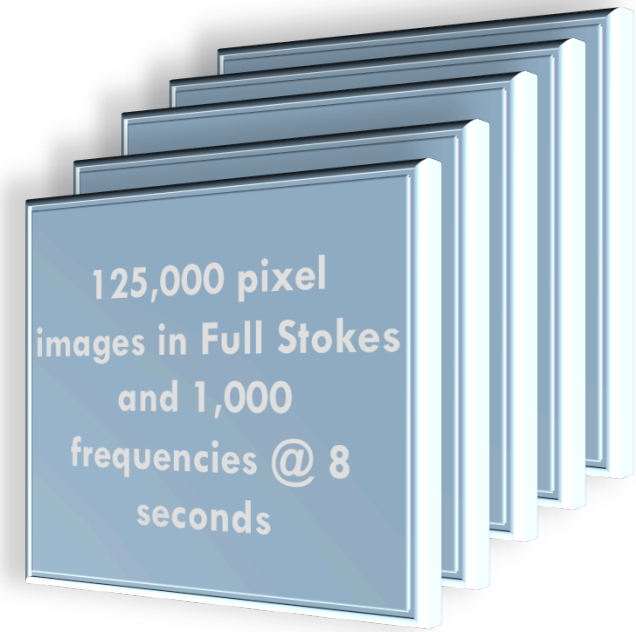


125,000 baselines x 1,000 frequency channels x 4 polarizations = ~ 4 Billion visibilities/sec

Real-time System

- Solve for location and power of hundreds of calibrator sources
- Determine offsets of sources due to ionospheric refraction
- Determine Faraday rotation of sources due to ionosphere
- Correct for these effects

Data products



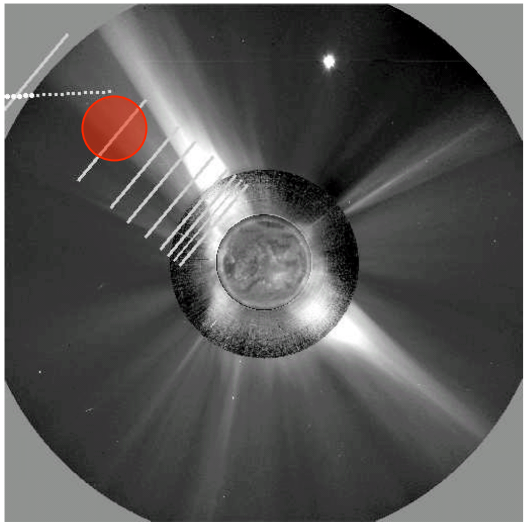
+ 32 digital beamformers

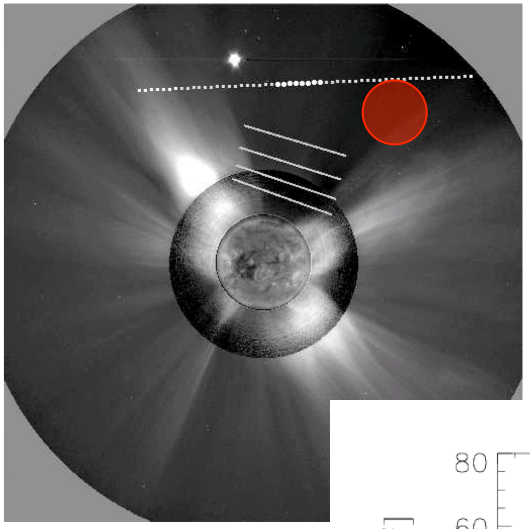
Solar Heliospheric and Ionospheric Science

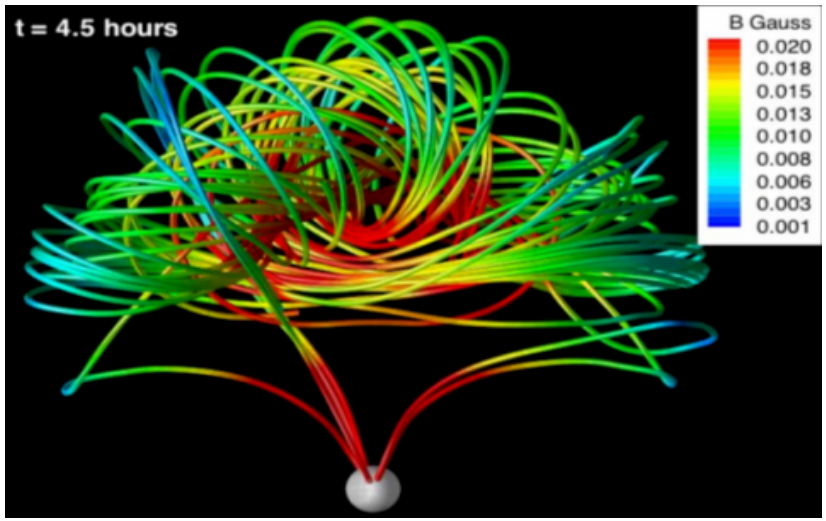
- Solar
  - Bursts
    - 8s images 32 MHz bandwidth 60 kHz full Stokes
    - 32 micro-sec arcmin beams
  - Turbulence
    - Angular broadening of sources near Sun
- Heliospheric
  - Faraday Rotation
  - Interplanetary Scintillations (IPS)
- Ionospheric
  - Distortion maps

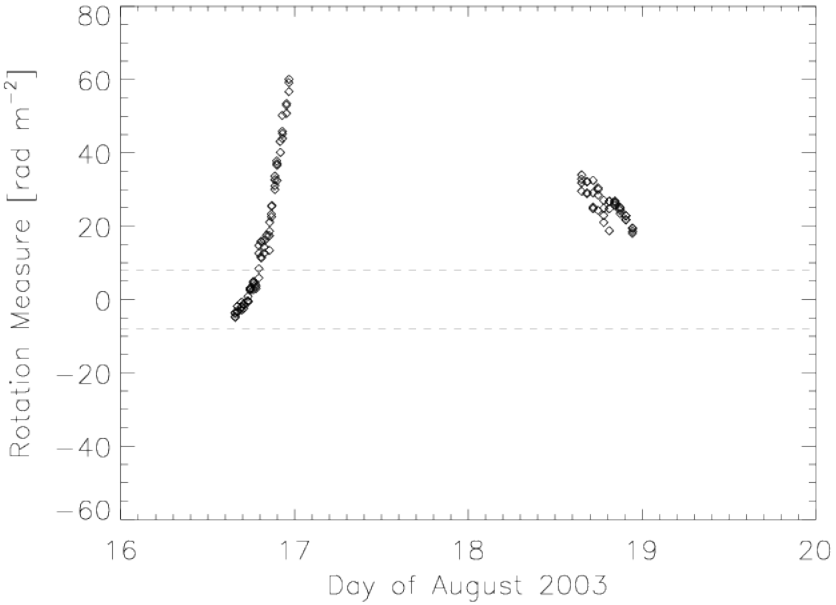
Observations of 3C228

Global models and turbulence

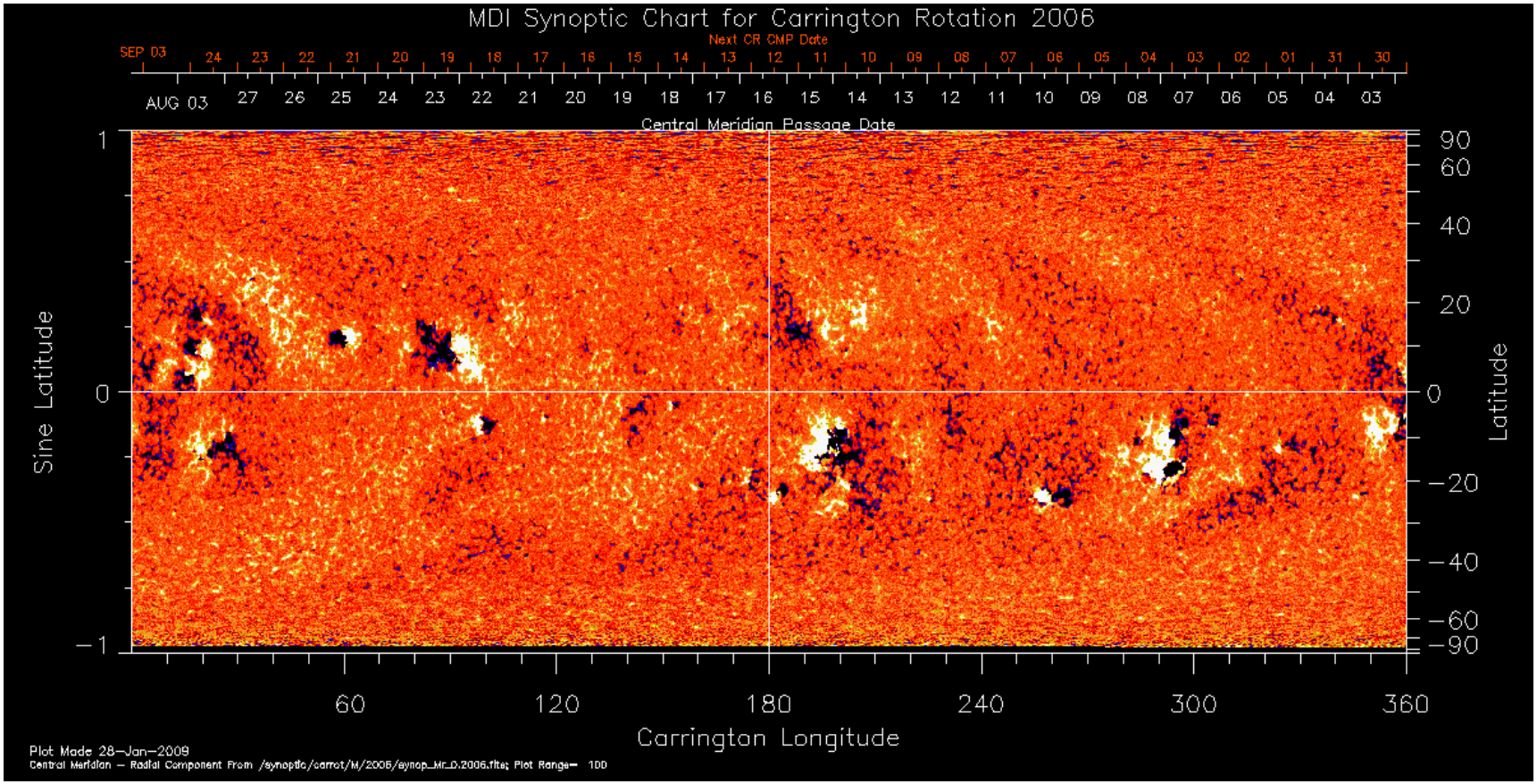




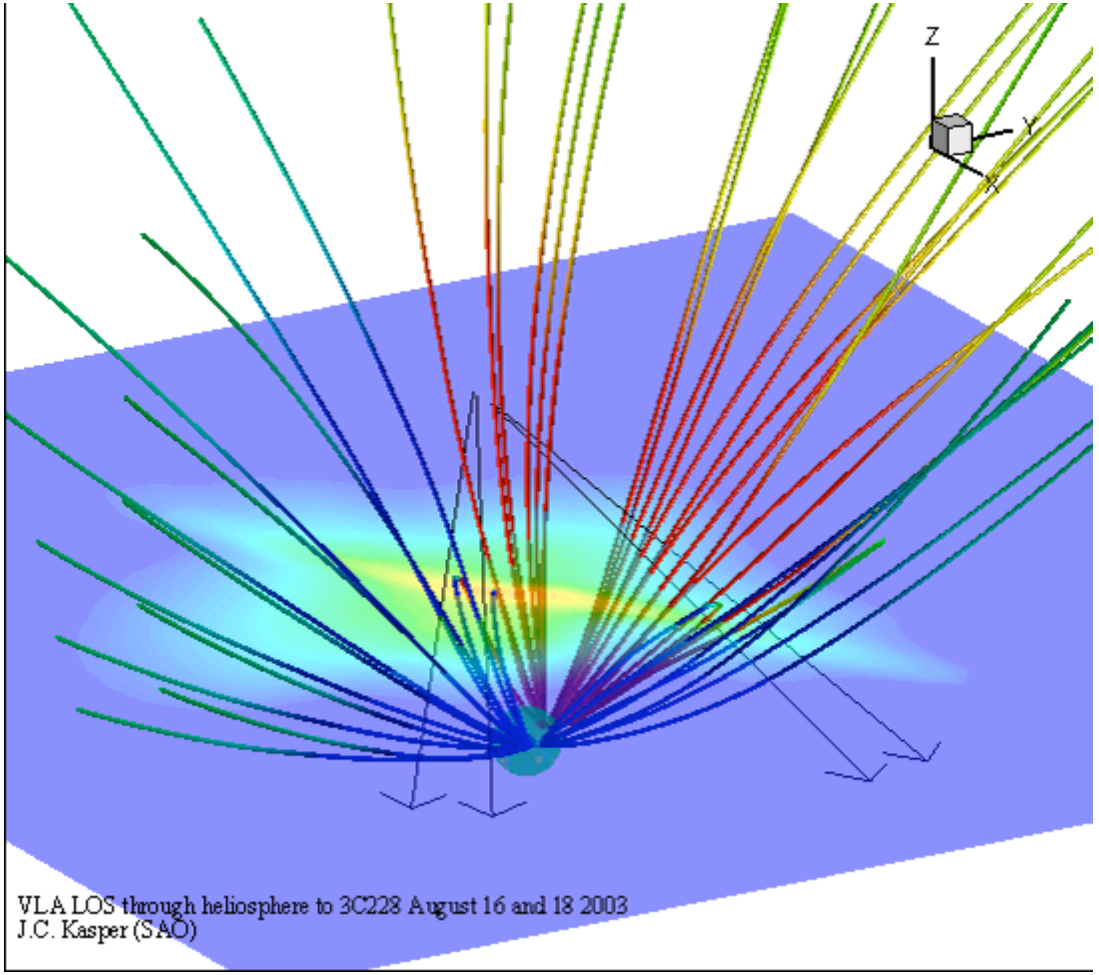




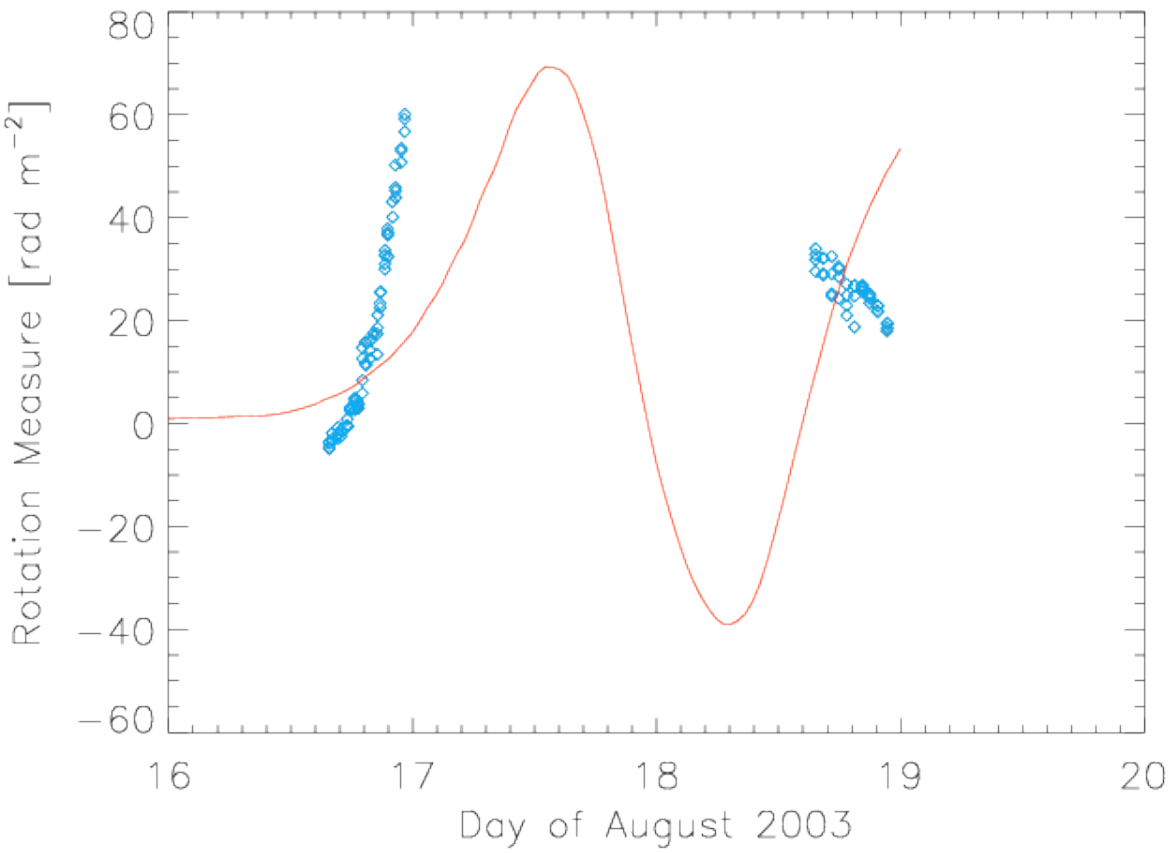
Start with photospheric field



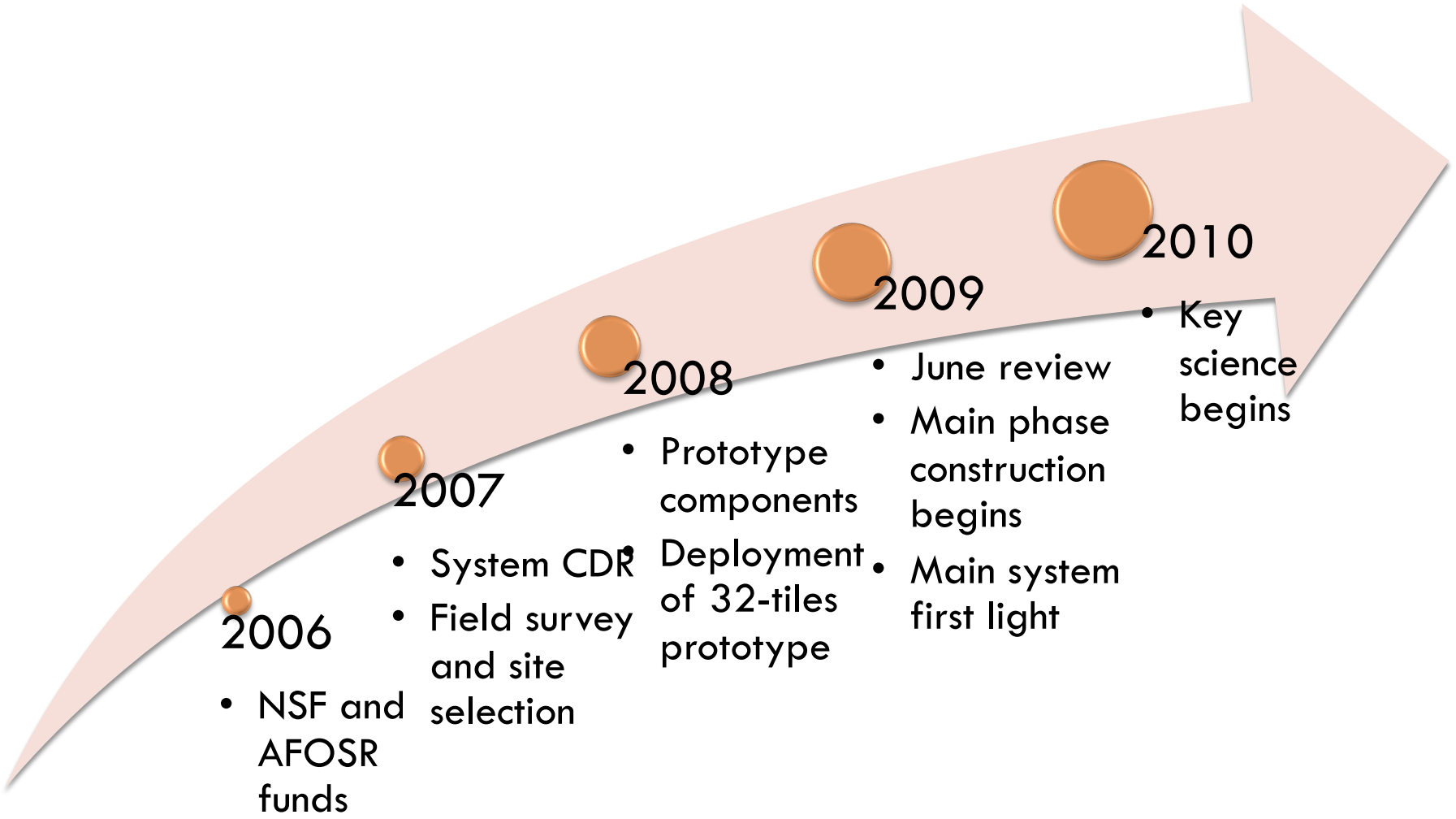
Lines of sight through 3D MHD Simulation

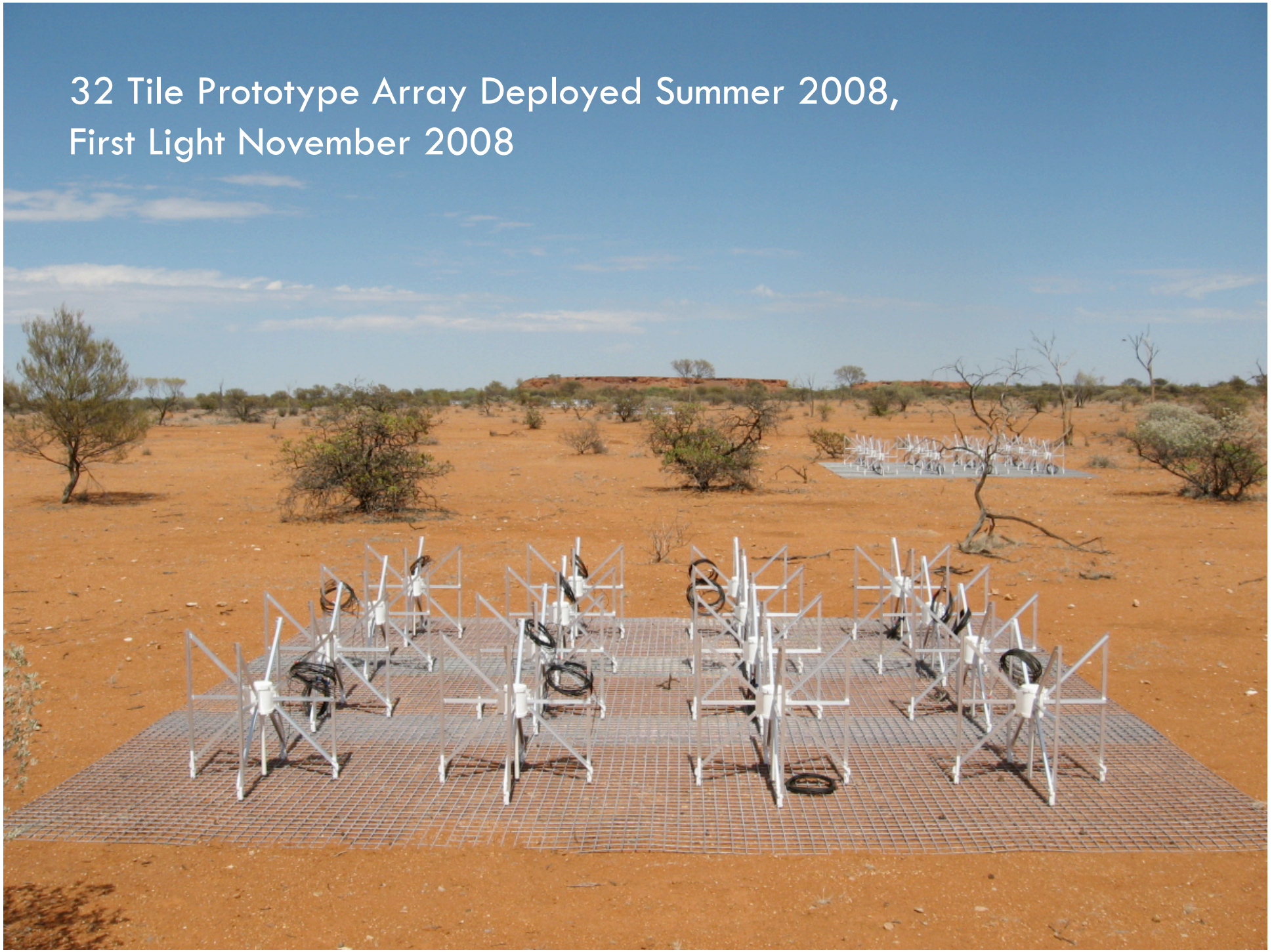


Observations and simulation

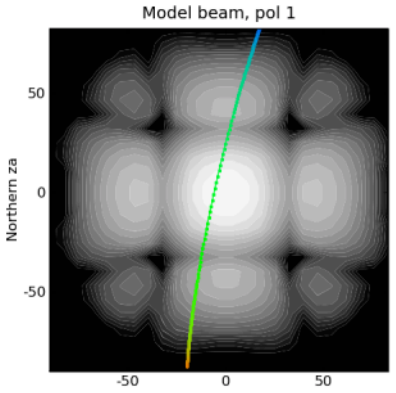


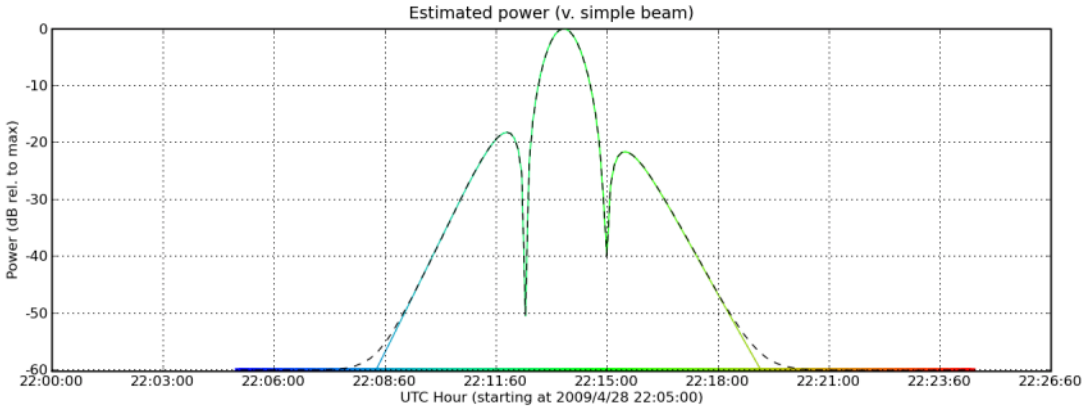
MWA development schedule

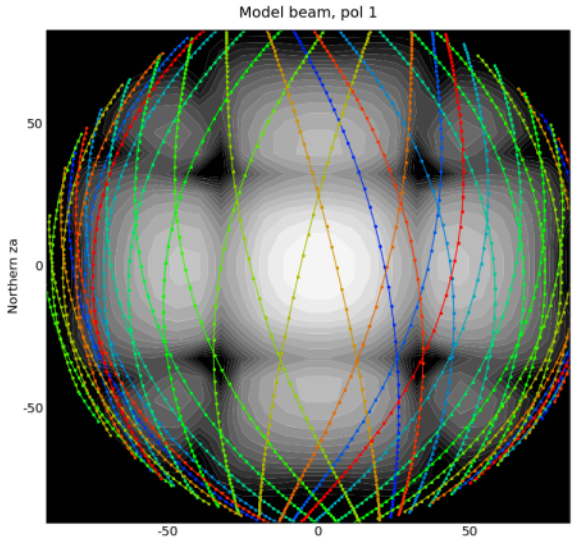


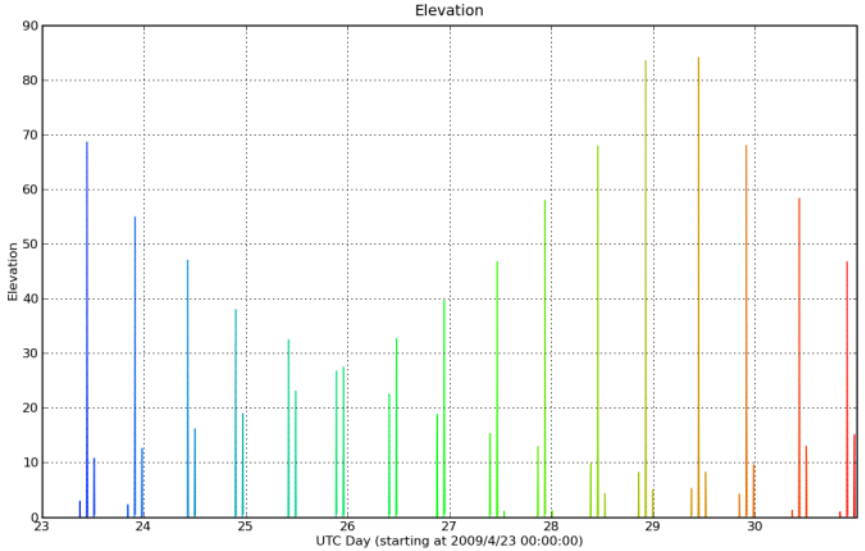

32 Tile Prototype Array Deployed Summer 2008,
First Light November 2008

Tracking spacecraft for calibration



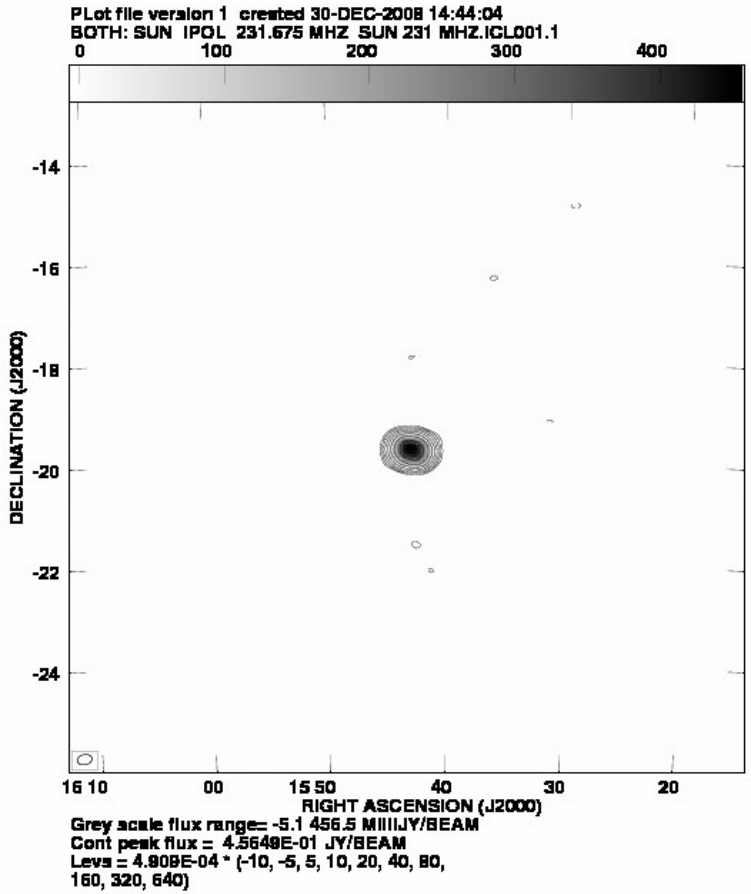


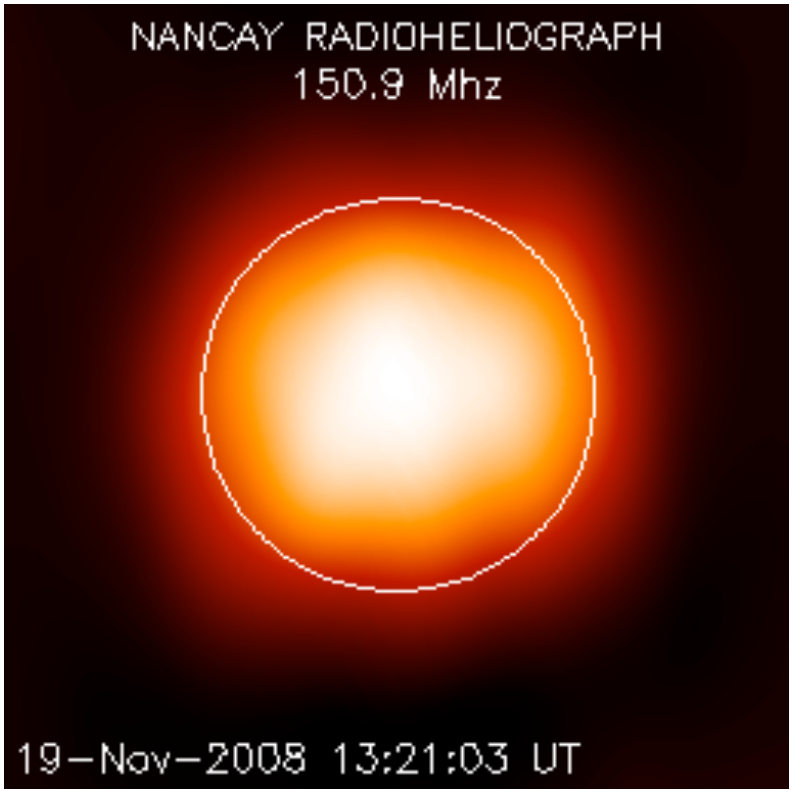




Daniel Mitchell

5 minutes of the Sun at 150 MHz

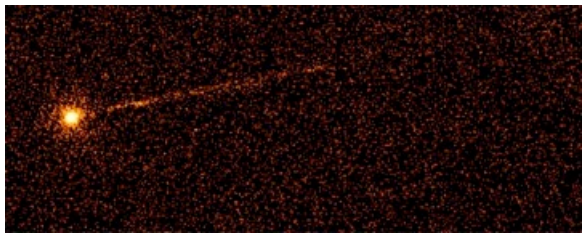


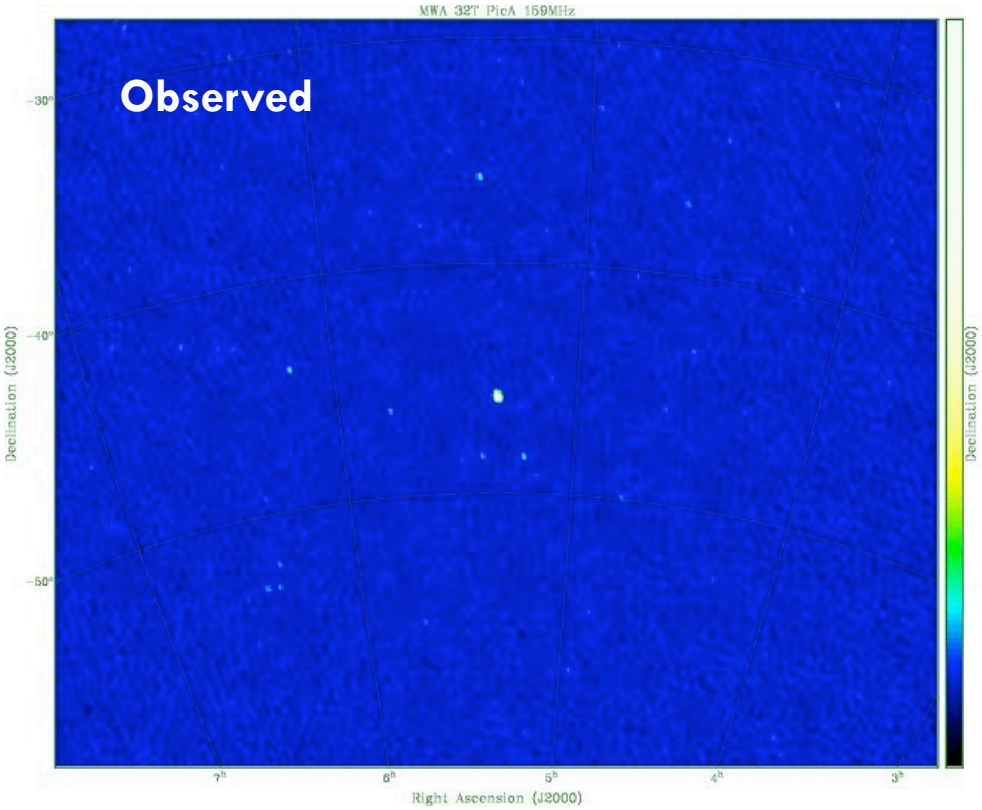


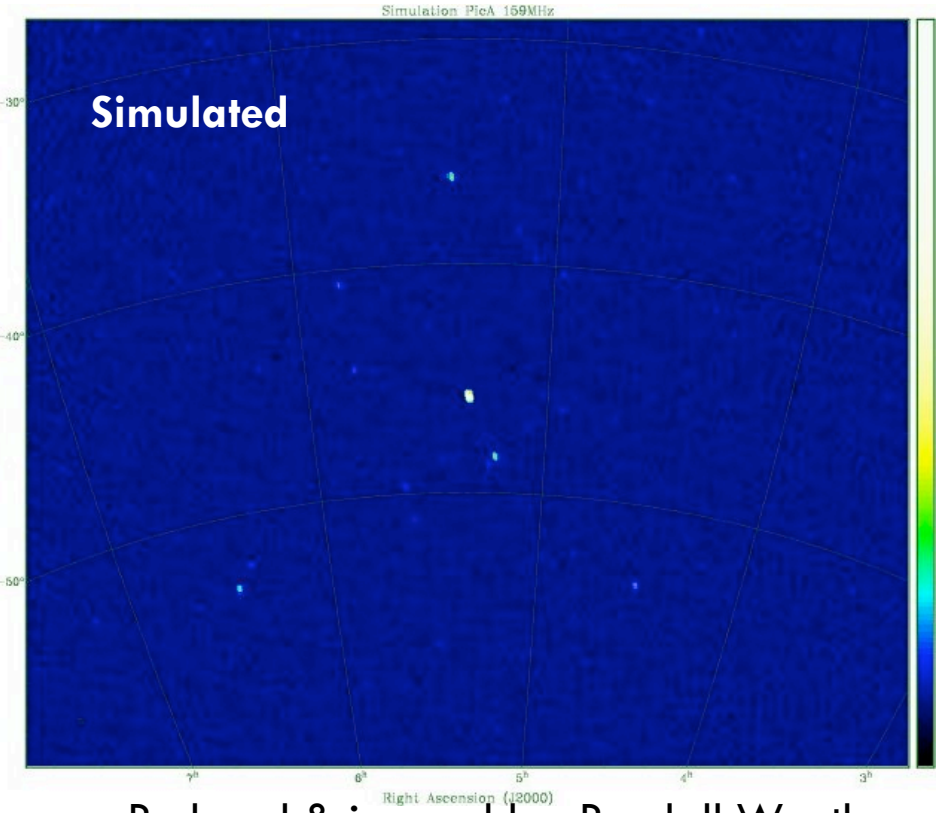
Reduced & imaged by: Vincent Fish

Pictor A (J0519-4546) at 158.72 MHz +/- 1.28 MHz

Radio galaxy Pictor A is a strong (~450.0 Jy at 160 MHz) source that will be one of the primary ionospheric and wide-field instrumental gain calibrators for the MWA

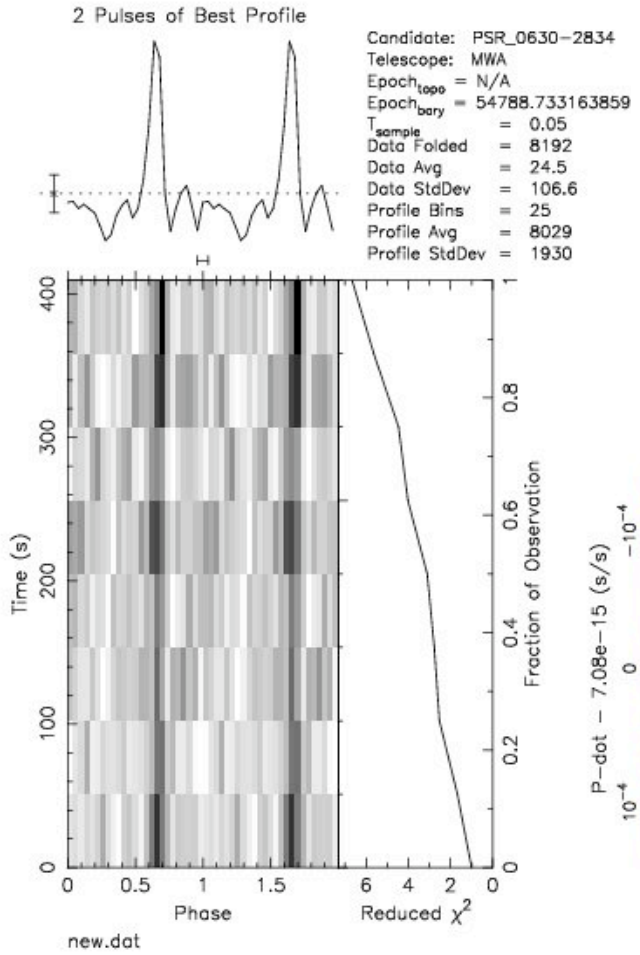


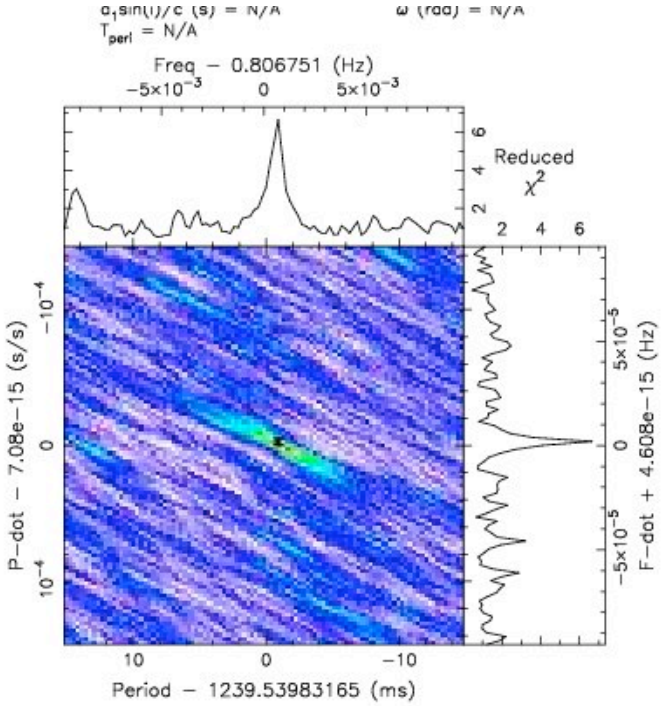




Reduced & imaged by: Randall Wayth

10 Minutes of PSR 0630-2834





PSR_0630-2834 is a pulsar with a period of about 1.24 seconds and a pulse width of about 50 ms. During each pulse the flux density is several Jy, with strong a linearly polarized component (60% - 70%).

Reduced & imaged by: Steve Ord

Conclusions

- MWA science
  - Faraday Rotation
  - IPS
  - Bursts
  - Ionosphere
- The 32-tile prototype has been fielded and is being tested extensively
- Start of full construction after review this month