

MWA observations of the diffuse polarised foreground

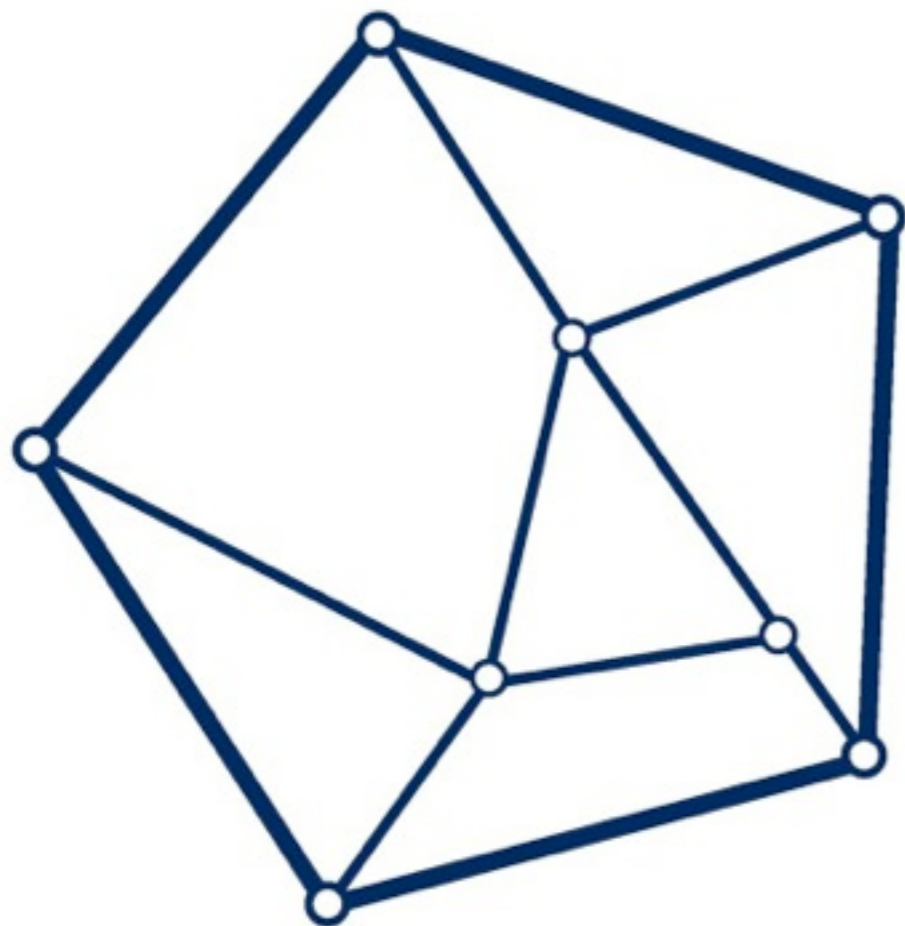
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**(+Gianni Bernardi, Daniel Mitchell, Pietro
Procopio, Ben McKinley)**

University of Sydney / CAASTRO

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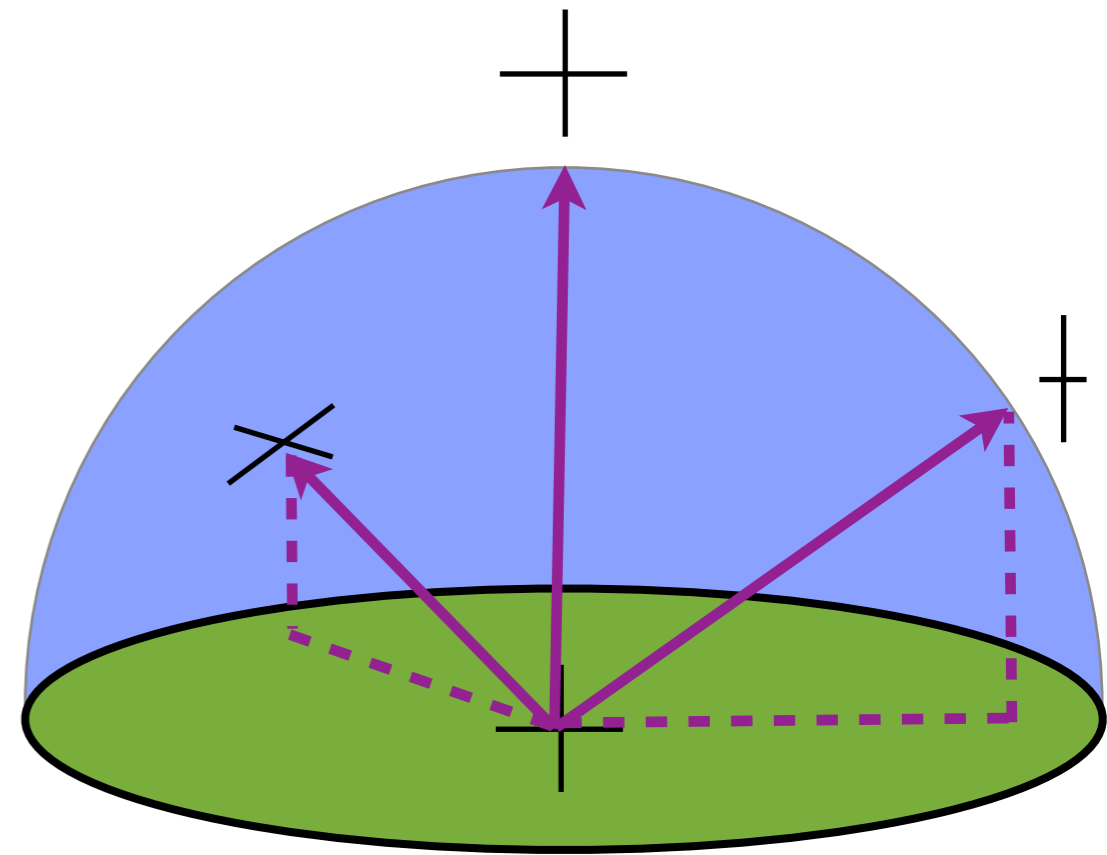
EoR Global Signal Workshop
21 November 2012



CSIRO; Swinburne



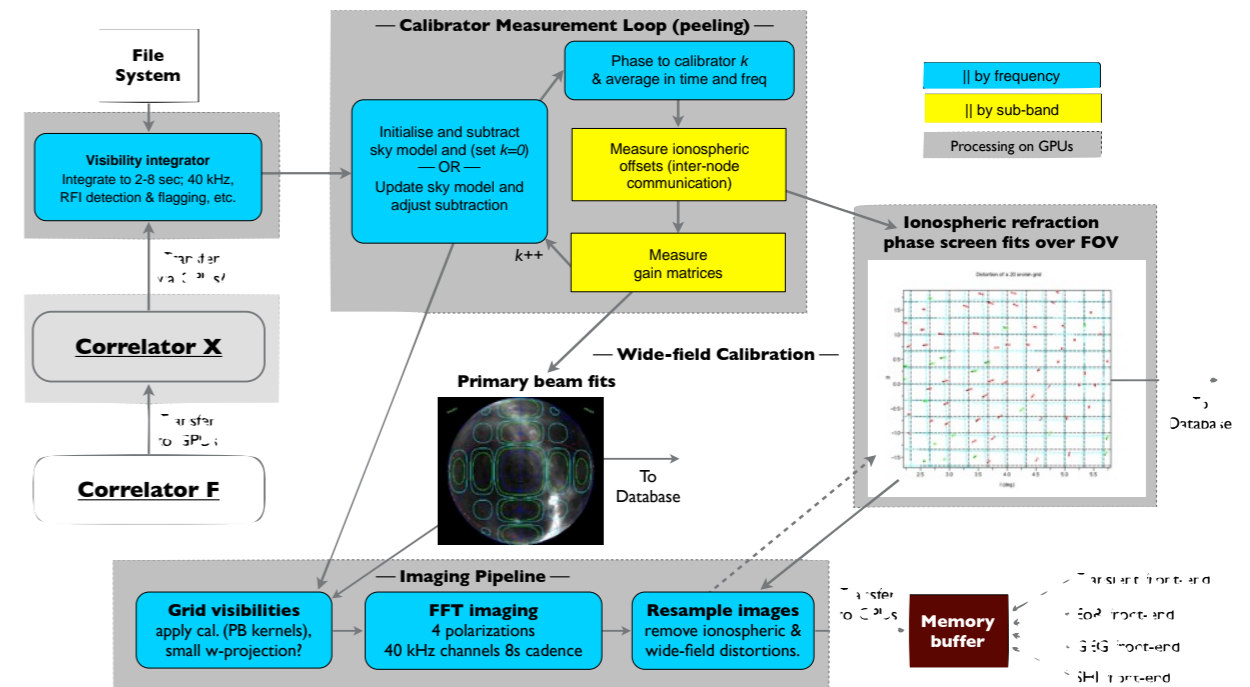
- Dipoles are only orthogonal and of apparent equal length for source at zenith.
- Projection effects elsewhere
- Sky rotates
- Large field-of-view
- Significant fractional bandwidth
- Polarised calibrators?
- Ionosphere





- Optimised processing

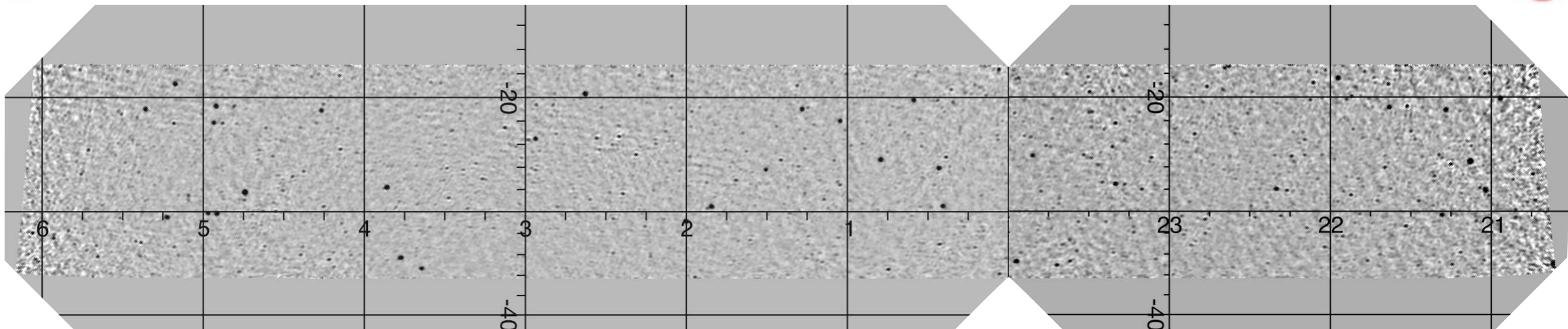
- Parallel + GPU
- Parallel + CPU
- CPU



- Full polarisation calibration for dipoles

- Ionospheric corrections (I28T)

- Deconvolution with Forward Modelling (as add-on)

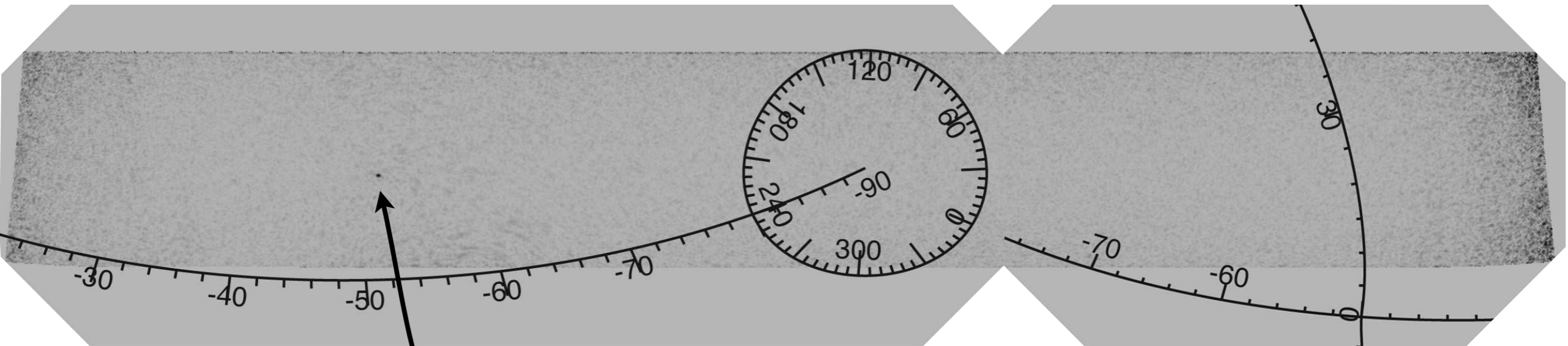


** Bernardi et al. A 2400 SQUARE DEGREE SURVEY AT 188 MHZ: BRIGHT SOURCES, FOREGROUNDS AND POLARIZATION

- Drift scan pointing at zenith over ~8 hours
- 2400 sq. deg at 188.8 MHz
- Forward modelling used to reach confusion limit
- Total intensity confusion limit at 200 mJy beam⁻¹
- 137 sources brighter than 4 Jy



MWA 188.8 MHz



** Bernardi et al. A 2400 SQUARE DEGREE SURVEY AT 188 MHz: BRIGHT SOURCES, FOREGROUNDS AND POLARIZATION

“The” polarisation calibrator (PMN J0351-2744).

- $I = 27 \pm 1.5$ Jy (170-200 MHz)
- $P = 320 \pm 15$ mJy
- $RM \sim 34$ rad m^{-2}



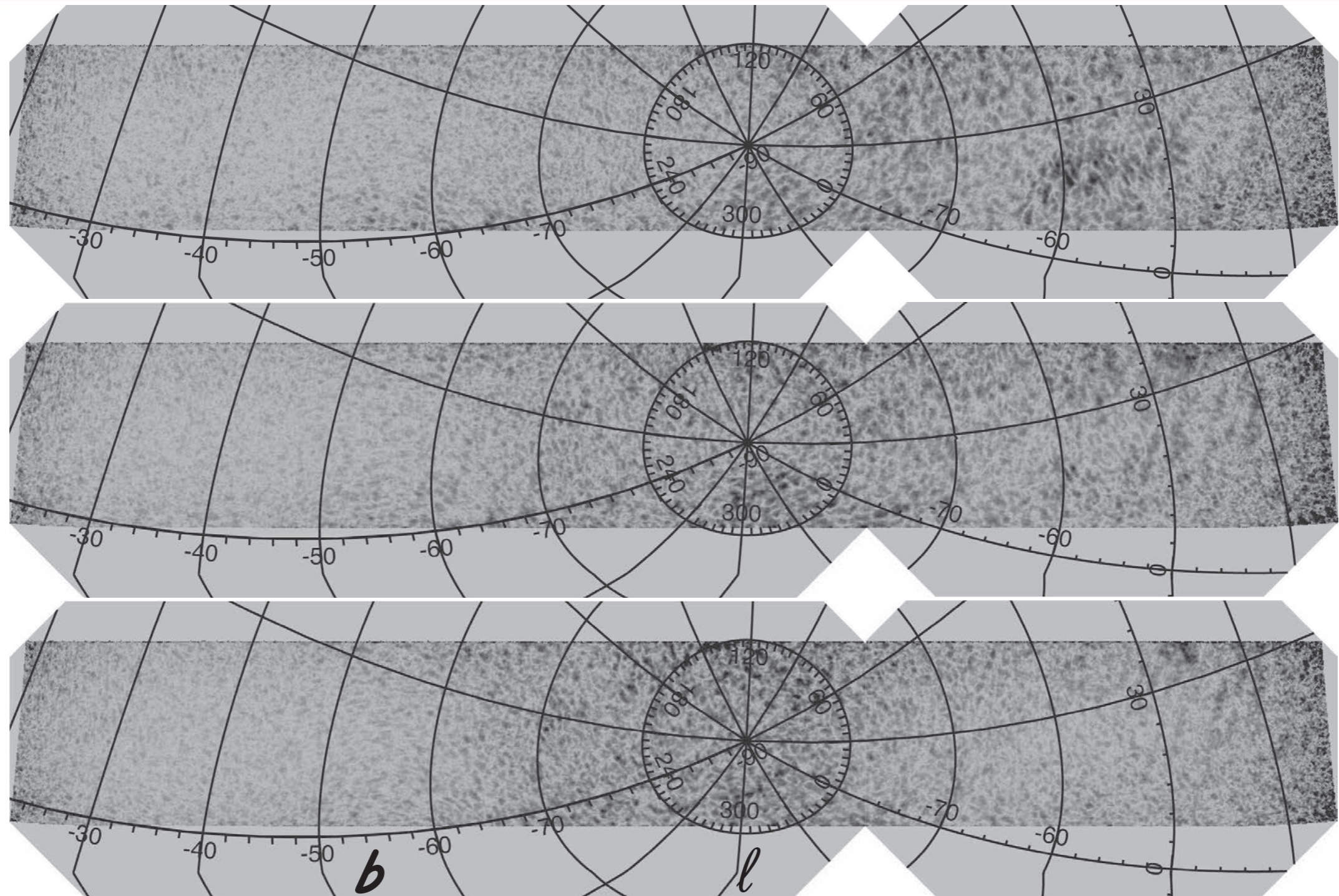
Diffuse Polarisation

- Probe of interstellar medium.
- Possible contamination of EoR measurements.
- Understanding of the global properties of the polarised ISM at low frequencies is limited by the available data.



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Diffuse Polarisation**

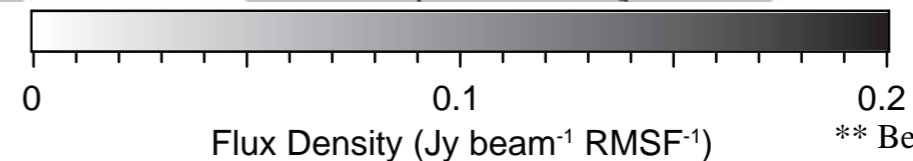


$\phi=0$

$\phi=2$

$\phi=4$

MWA 188.8 MHz, 20° strip, $b < -20^\circ$

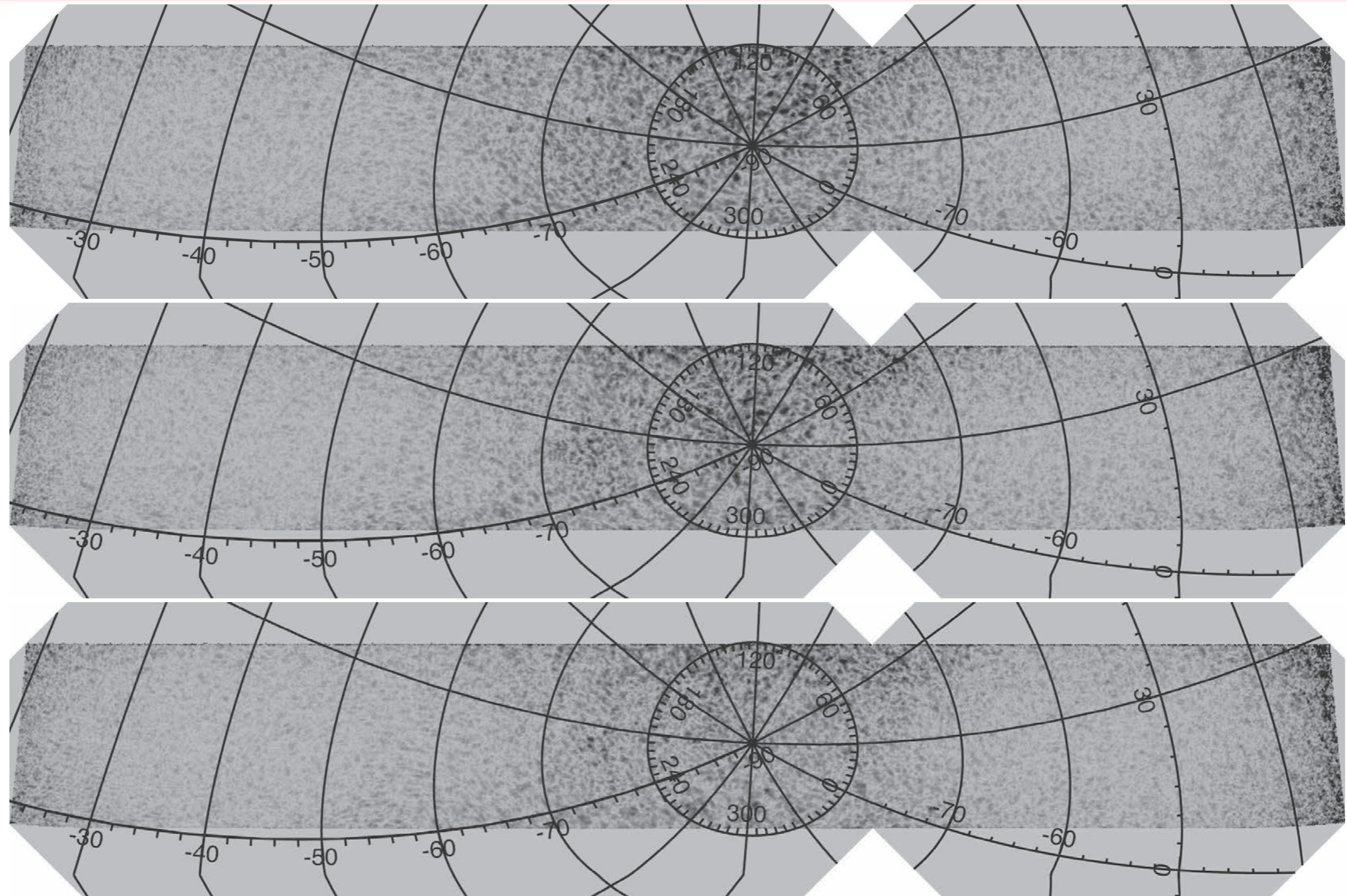


** Bernardi et al.



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Diffuse Polarisation**

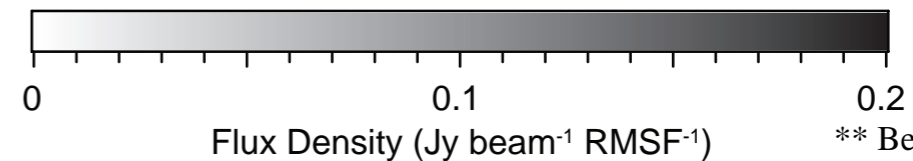


$\phi=6$

$\phi=8$

$\phi=10$

MWA 188.8 MHz, 20° strip, $b < -20^\circ$



** Bernardi et al.



- Q/U not calibrated for absolute position angle (no calibrator available at these wavelengths).
- Short baselines weighted down.
- Sensitive to scales < 4 deg.
- Polarised emission weak at these wavelengths (depolarised).
- Brightest peaks at ~ 13 K RMSF $^{-1}$ at $|\phi| < 20$ rad m $^{-2}$.
- Faint (~ 2 K RMSF $^{-1}$), patchy emission exists up to $|\phi| < 20$ rad m $^{-2}$.



Diffuse Polarisation

- Observed lack of correlation with total intensity (foreground ISM rotates smooth polarised background).
- Emission most likely from foreground ISM (very local origin < 120 pc). Anything further out is depolarised - “polarisation horizon” (Landecker et al. 2001)
- Depolarisation may be due to resolved large-scale polarised background, depth and bandwidth depolarisation.



- Drift scans ($\sigma < 20$ mJy/beam in polarisation)
 - $\delta = -27^\circ, -47^\circ$ (number of interesting fields e.g. A-Team sources, J0444-2809 and the EoR I field)
 - $\delta = -27^\circ$ scan includes existing polarisation calibrator.
 - Repeated observations for different configurations.
- EoR scans (include Pol. Cal.)
- Sky survey
- Multi-band coverage
 - Wider λ^2 space helpful for RM synthesis.





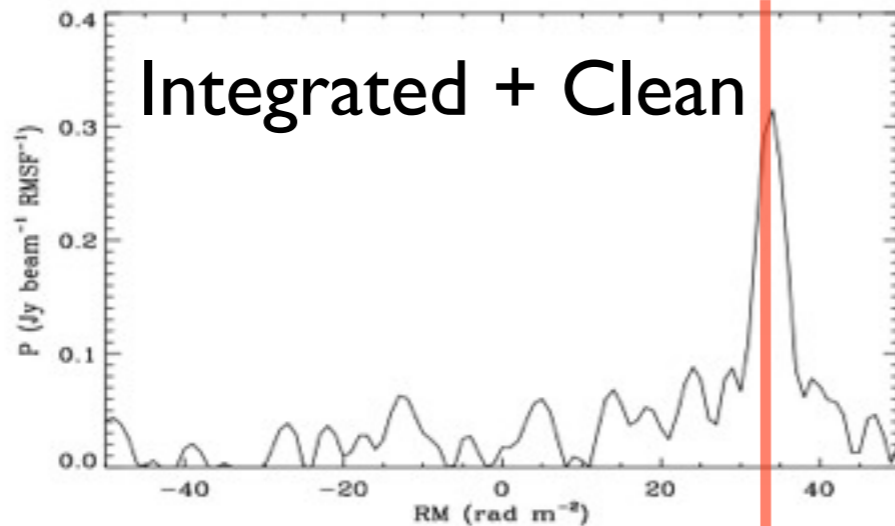
Critical Acceptance Tests

- Test detection of polarised point source.
- Test effectiveness of polarisation calibration with different beam-former settings.
- Polarisation leakage across field containing a bright calibrator source (now have Stokes V).
- Diffuse polarisation tests.
- Repeat for different bands and different configurations (tests for depolarisation).
- ... search for additional polarised point sources.



Latest results using RTS

32T



$\nu_c = 189$ MHz

2 minute scan $\Rightarrow 10 \sigma$!!

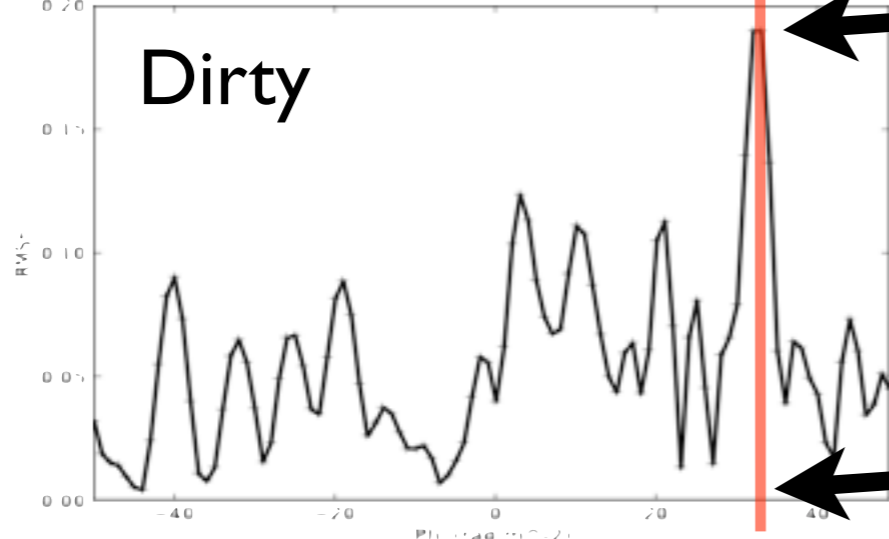
Delta



$\nu_c = 141$ MHz

$P = \sim 200 \pm 20$ mJy

Gamma



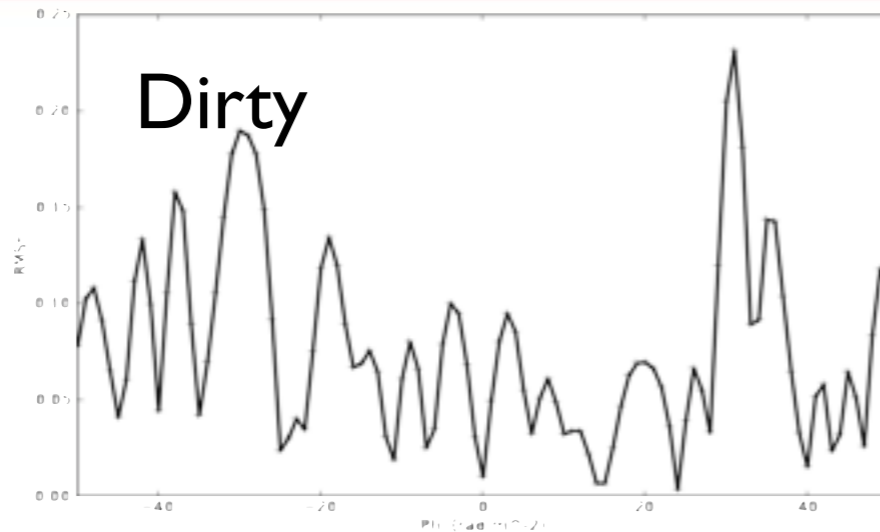
$\nu_c = 141$ MHz

RM ~ 34 rad m^{-2}



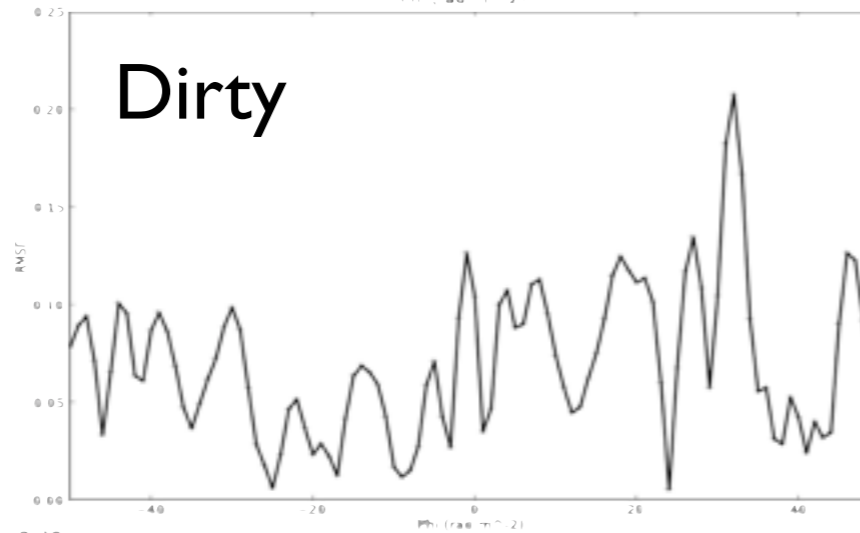
Latest results using RTS

Epsilon



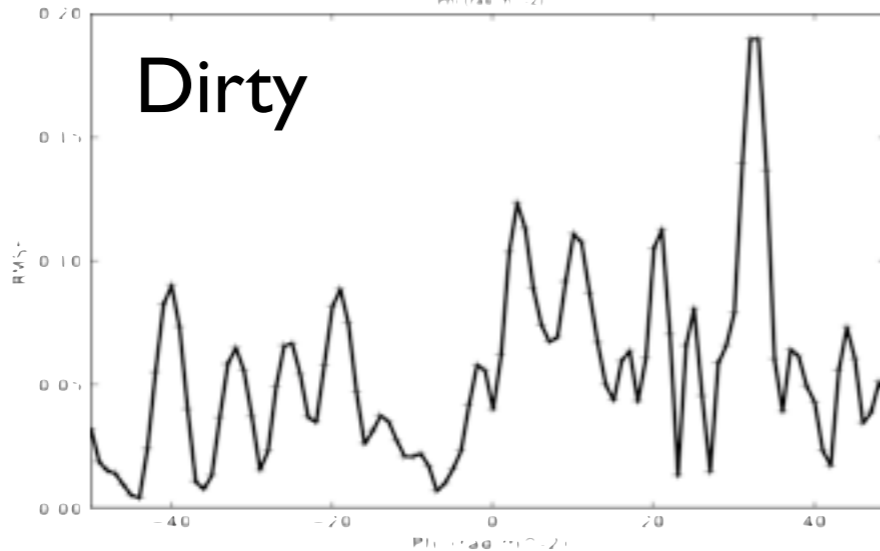
$\nu_c = 141$ MHz

Delta



$\nu_c = 141$ MHz

Gamma

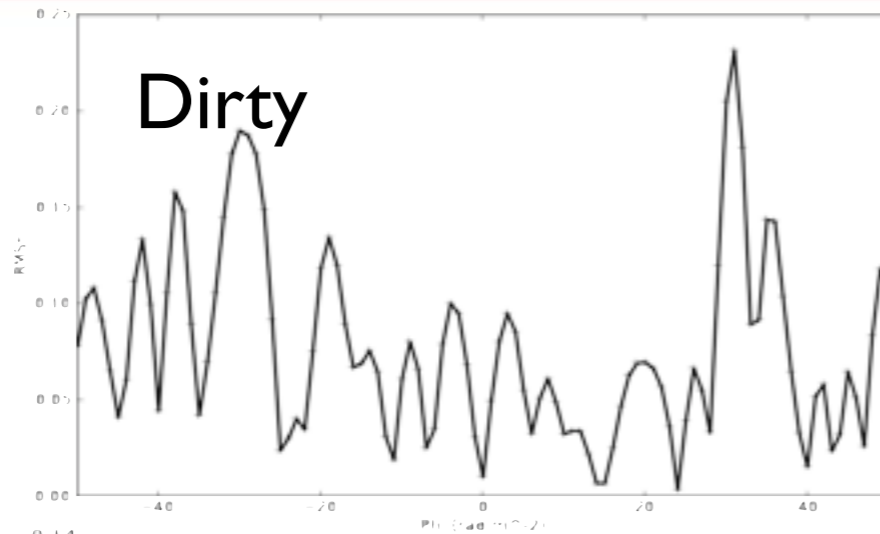


$\nu_c = 141$ MHz



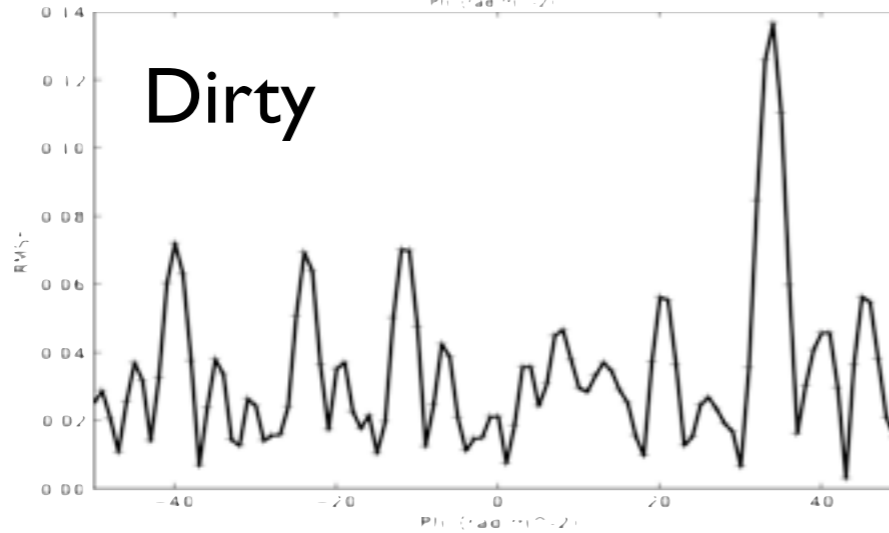
Latest results using RTS

Epsilon



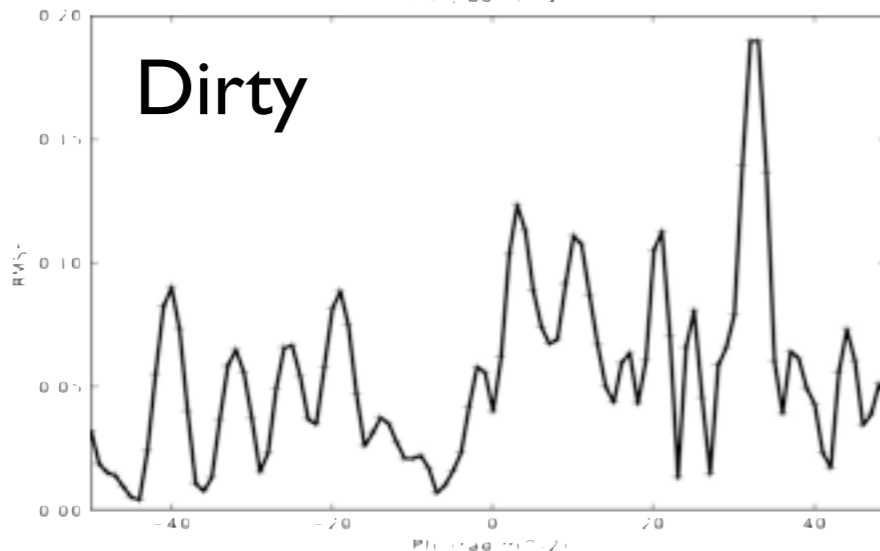
$\nu_c = 141$ MHz

**Epsilon
(Offset)**



$\nu_c = 141$ MHz

Gamma



$\nu_c = 141$ MHz



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MWA Alpha - Fornax A?



Frames in RM space -10 to 10



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The Beginning ...

Stay tuned for more